The AMSAT® Journal

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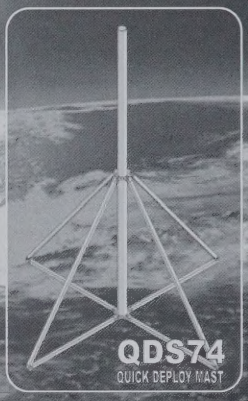

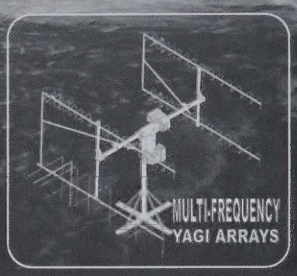

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**See our review, QST March 2016 page 60.*

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AMSAT Announcements

2017 AMSAT Space Symposium and Annual Meeting

Silver Legacy Resort, Reno, Nevada — October 27-29, 2017

The annual AMSAT Space Symposium features:

* Space Symposium with Amateur Satellite Presentations
* Operating Techniques, News, & Plans from the Amateur Satellite World
* Board of Directors Meeting open to AMSAT members
* Opportunities to Meet Board Members and Officers
* AMSAT-NA Annual General Membership Meeting
* Auction, Annual Banquet, Keynote Speaker and Door Prizes!

Several members from The Sierra Nevada Amateur Radio Society (SNARS), as well as many other local radio amateurs will be participating in helping with this event.

Room reservations may be made at the following web address:
https://silverlegacyreno.reztrip.com/ext/promoRate?property=1080&mode=b&pm=true&sr=220262&vr=3

Additional information about the 2017 AMSAT Symposium will be posted on the AMSAT web site, **www.amsat.org** as it becomes available.

AMSAT's Mission
AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision
Our Vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.

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Apogee View

Barry Baines, WD4ASW
President

Greetings from New England! As I write this column on Memorial Day, the temperature is 50 degrees, overcast, and everyone around here is wondering if/when spring will arrive. This has been a cold and wet time in New England.

Hamvention

That said, proof that there is indeed a spring was reinforced with this year's Hamvention, which took place at a new venue, the Greene County Fairgrounds in Xenia, OH. While Hamvention did experience some serious thunderstorms, that did not dampen the spirits of the attendees. And despite the rain, the temperatures were higher than when I left Boston.

The Dayton Amateur Radio Association (DARA) successfully pulled off the transition from Hara Arena to the Fairgrounds, and everyone I've talked to is impressed by the results. Some glitches occurred, such as the traffic jam on Friday morning getting into Fairgrounds. Cars were stuck in the mud both in the flea market and the general parking in the soccer fields due to water accumulation from the storms. And even despite long lines for the food vendors, these issues did not appear to create an overall negative impression. After the Friday morning traffic problems, county officers made adjustments to the traffic flows to reduce congestion leaving Friday evening, as well as ensure a smooth traffic flow on Saturday and Sunday.

This year's Hamvention was unique because EVERYONE was a "newbie" at the new location. Even those of us who have attended Hamvention for 35+ years had to start all over again learning how to get to Hamvention, the locations of the 250+ commercial vendors, along with where to find the food vendors and what they were offering. The new venue certainly provided a county fair atmosphere.

For AMSAT, the transition to the new venue provided a fresh opportunity to rethink our booth setup. We worked with Hamvention officials to ensure an effective location for our satellite demonstrations. Our Hamvention Team Leader, Steve Belter, N9IP, worked with Hamvention Indoor Exhibits Chairman Brian Markland, N8UDQ, who bent over backward to accommodate us. Their efforts resulted in an outstanding location for the AMSAT exhibit area (8 booth spaces) in Building 1 that took up the entire aisle to one side to the main entrance which also provided an opportunity to place the satellite demo area on the outside wall opposite from our Engineering Team, Education, and ARISS areas.

We had plenty of space to highlight AMSAT and the activities that we're engaged in, offering a variety of "satellite fashions" and satellite antennas, handling new and renewing memberships, and demonstrating satellite tracking software. Providing directions to the satellite demo area was a simple, "Go out the main door and make a right." Paul Stoetzer, N8HM, and his team were masterful in demonstrating satellite contacts to crowds of people as they worked the various linear and FM satellites throughout the weekend. The 2017 edition of "Getting Started with Amateur Satellites" was offered for the first time at Hamvention and became an instant best seller. The new AMSAT polo shirt, t-shirts, and cap were hits. Thank you to the number of individuals who staffed the booth, answered questions, processed memberships, and handled the satellite demonstrations. Kudos to all!

Steve Belter, N9IP, successfully transitioned AMSAT to the new venue and ensured that our volunteers became familiar with the new setup. We had plenty of volunteers to help setup on Thursday and take down on Sunday afternoon. Thanks to Steve's leadership during Hamvention, I wasn't aware of any significant "oops" that took place at the AMSAT booth. Having Steve as our Team Leader certainly provided steady leadership as we adjusted to the new venue.

The AMSAT Forum that took place Saturday morning was well attended with a packed house in a room with over 250 chairs. Unlike our experiences in Hara Arena, where the Forum took place in a room with curtains for walls (allowing noise from the Hamvention commercial area in Ball Arena to compete with the Forum's PA system), our space this year was in a separate building. Our presenters provided attendees with information about AMSAT, our engineering programs, an overview of current and soon-to-be-launched satellites, educational outreach ("NextGen Crystal Radio"), and ARISS. My thanks to Joe Spier, K6WAO (AMSAT V. P. of Educational Relations), for serving as our Forum Moderator.

With another Hamvention in the record books, my thanks to Steve for his four years of service as our team leader. Steve has informed me that he is stepping down as our team leader, and we'll be looking for a replacement to lead AMSAT's presence at the

2018 Hamvention. Steve is willing to serve as consultant to assist in the transition, and our booth volunteers are now accustomed to the new location. So, if you're interested in making a difference for AMSAT by becoming our next Hamvention Team Leader, please don't hesitate to contact me.

Board of Directors Election & Leadership Changes

Nominations for candidates for the AMSAT Board of Directions were due at the AMSAT Office in Kensington, MD, no later than June 15, 2017. Ballots will be mailed to the AMSAT membership by July 15. The AMSAT Bylaws stipulate these dates. As the nomination deadline will have passed by the time most of you read this column, I want to take a moment to discuss the importance of voting for this year's nominees and the impact that this election has on the future of AMSAT.

The Class of 2017 Directors up for re-election for two-year terms consists of Drew Glasbrenner, KO4MA, Bob McGwier, N4HY, Jerry Buxton, N0JY, and myself. In addition, we elect two board alternates who serve for one year. The alternates are fully engaged in board deliberations but are non-voting. In the event we need to replace a board member, the first alternate will fill that seat until the next election when that position will be open for nomination once again to fill the remainder as needed. The current alternates are Paul Stoetzer, N8HM, and Clayton Coleman, W5PFG. The three board members elected in 2016 for two-year terms will be up for re-election in 2018.

At this point, it appears that two of the four incumbents will not be standing for re-election. Bob McGwier, N4HY, has indicated that he does not intend to run because of the time constraints of his professional responsibilities. I also have decided not to stand for re-election as well. It is time to bring the next generation into positions of leadership.

I first became a voting board member in 1999, prior to the AMSAT Space Symposium in San Diego, while serving as AMSAT's Director of Field Operations. I am currently holding the second longest tenure on the board (this is my 18th year), having been elected by the AMSAT membership to nine consecutive two-year terms. Before my election, I was a board alternate.

My past 18 years serving on the board have allowed me to directly help influence the strategic direction of AMSAT, including participation in various strategic planning processes, as well as the current strategic planning effort. I have been privileged to serve an organization that has completed some marvelous projects over the years. We have focused on scientific and educational objectives that have kept amateur radio in space despite the external changes taking place around us. These changes have influenced both the types of projects we've pursued as well as the financial impacts of those projects.

Given that there are two open positions on the board that takes office on September 15, 2017 (when the board election results are announced), a unique opportunity exists for AMSAT members to consider who they want to set the strategic direction of AMSAT. I expect that some "new faces" will be elected to the board. Please take the time to review the candidate's statements when you receive them in July, and make a decision as to who you'd like to see on the board. Your vote is one of the benefits of AMSAT membership, so please utilize this opportunity.

Coupled with my decision not to run for the board, I also informed the AMSAT Board of Directors in 2016 of my decision not to accept another one-year term as AMSAT President when the board meets in Reno, NV, before the 35th AMSAT Space Symposium and Annual Meeting.

The reasons for my decision reflect the evolving stages in life that we all go through. I have served as president since 2008, having been elected by the board for nine consecutive terms. Nine years is a long time for one president to serve an organization such as AMSAT.

After nine years of a volunteer "full-time job," it is time for new blood to lead the Radio Amateur Satellite Corporation, not only because "nine years is enough" for me, but also because there comes a time for someone else to bring a different perspective to the office as well as the energy needed to take on new and different opportunities.

The skills that I brought to this position in 2008 were helpful in resurrecting an organization that had just hit a low point in its existence. I was willing to help rebuild AMSAT with the assistance of several capable individuals who I asked to take on leadership positions. None was more critical than Tony Monteiro, AA2TX (SK), who served as VP of Engineering from 2008-2014 and developed the strategy of using CubeSats as the best approach for successfully returning AMSAT to space under an affordable and technically achievable program.

Tony also provided support for SuitSat-2 (which morphed into ARISSat-1) led by Project Manager Gould Smith, WA4SXM. Though the project schedule was extended for a variety of reasons, ARISSat-1 was deployed from the ISS in August 2011. It marked a huge technical success and symbolized our efforts to restart AMSAT-NA as the Fox program moved forward. Four months later (November 2011), AMSAT submitted its first CSLI (CubeSat Launch Initiative) application to NASA under the ELaNa (Educational Launch of NanoSatellite) program. Our proposal was selected in February 2012, which later became Fox-1A/AO-85, launched in October 2015. Since the decision to build Fox-1A, four more Fox-1 series satellites have found launches. Hopefully, we will see all five in orbit in the near future.

As we've moved forward over the last nine years, it is also becoming clear that AMSAT is currently at a crossroads. I've noted that in my prior "Apogee View" writings about strategic planning. One of the key guidelines for strategic planning is that those that design and develop the strategic plan should be the ones to implement it. That's because those with "skin in the game" are more likely to support and help make the implementation process a success.

The board and the Senior Leadership Team held a strategic planning kickoff meeting in Orlando this past March, but that was only the first step in a process that could take a year or more to develop and successfully implement. Consequently, a new president taking office this October will be in position to participate and support the planning process and guide the implementation as one who helped design it.

Given my decision to conclude my service as president this fall, the board has responsibility for finding the next president. As we approach the end of my term of office, the board is focusing on identifying potential candidates that presumably will have the skillsets necessary to take AMSAT forward to the next level as defined by the strategic planning process.

Along with the conclusion of the Fox-1 program, AMSAT finds itself needing to decide what the president is expected to focus his/her energy on and what skills are necessary to achieve the strategic goals developed by the board. For example, how critical is revenue generation (one of the strategic objectives) and are there expectations on the role that

the president may have in this area? Is grant writing or developing a capital campaign for the next series of amateur satellites something that the president will need to be leading? What role should the president have concerning "Membership Engagement and Communication," another focus area identified during the kickoff meeting in Orlando? These are the types of questions that the board will presumably consider as it decides who should lead AMSAT.

Lastly, my wife Kathy, WD4ASX, retired from the ministry in October 2016 following 37 years as a Lutheran pastor, which means a change in our priorities, including relocating and spending time in New England and Texas to be near two sets of grandchildren. Those opportunities coupled with wanting to have time to complete a satellite station and operate HF also means having time to actually focus on amateur radio rather than manage an amateur radio organization.

Retirement also means being able to travel and being more flexible in how we spend our time. We're not getting any younger, and the desire to be able to redirect our priorities is important as we move into a new stage of our lives together as we're in our 42nd year of marriage.

In the meantime, we celebrate our recent successes (such as Hamvention), plan for those activities taking place later this year (such as the AMSAT Space Symposium in Reno, NV), and focus on preparing the organization for a transition reflected both in the election of a new slate of Board of Directors and preparation for a transition in the Senior Leadership Team.

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AMSAT Strategic Planning Update

Introduction and Overview

Barry Baines, WD4ASW President

In previous issues of *The AMSAT Journal*, we've highlighted the decision by the AMSAT Board of Directors to initiate a strategic planning process in 2017. As the board is responsible for the strategic direction of AMSAT (while the President and Senior Leadership Team handle day-to-day 'tactical' affairs), there is a need for the board to step back and take a serious and reflective look at the future using a strategic planning process that encompasses a variety of areas.

Adding to the need for such a process is that the Fox-1 program will soon complete the last of the series (as currently planned) in late 2017 or early 2018. AMSAT Engineering is working towards creating the "five and dime" ground terminal that has potential application in a variety of uses (including Phase-4B, CubeQuest Challenge with Ragnarok Industries, and a HEO 6U CubeSat concept). That makes the coming year an appropriate time for the board to establish a multi-year plan that builds on our accomplishments and encourages the organization to "push the envelope," subject to the resources and capabilities that currently exist within AMSAT, while recognizing the perceived impact of externalities that influence the organization.

In 2004, the board adopted the last thorough strategic plan, with an update in 2009, when the board decided to accept the recommendations of the Engineering Task Force (led by VP-Engineering Tony Monteiro, AA2TX (SK)) to establish the Fox-1 program. Given that the board last considered a strategic plan seven years ago, now is the time to focus on it again.

Along with the recognition that the board needed to conduct a strategic review, we realized that most current members of the board were not involved in the prior planning processes in 2004 and 2009. Of the seven current voting board members, only two (Tom Clark, K3IO, and Barry Baines, WD4ASW) were members during the prior planning process in 2004. Thus, the board reviewed what constitutes strategic planning and why we needed to dedicate time and effort to initiate and sustain such an effort.

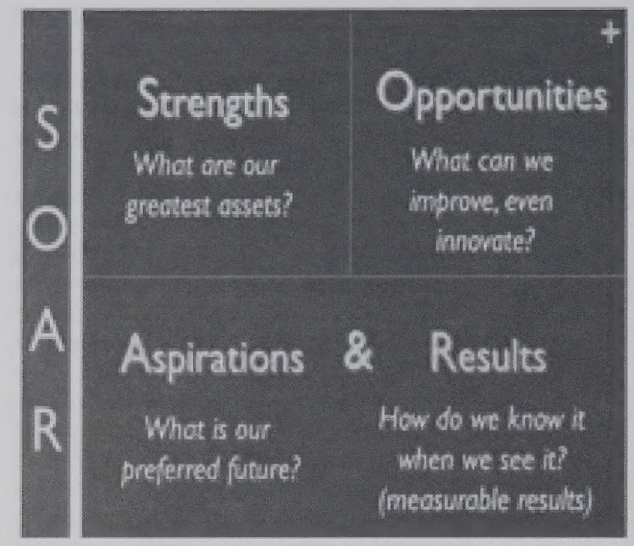
After board discussion in Galveston last November, we considered how best to manage the strategic planning process. A key consideration was to find an outside facilitator to help guide the conversation and establish the process for the board to utilize as a means of reaching consensus on what is important for the future of AMSAT.

We selected Tony Silbert, MSOD of Spartina Consulting, to serve as our facilitator. See **www.spartinaconsulting.com.** Two aspects of Tony's approach were important to us: (1) building on our strengths, and our 47 years of distinguished history; and (2) creating "ownership" for making the strategic plan successful. In other words, those that are fully engaged in the creation of a strategic plan are more likely to make the commitment for implementation. We recognized the importance of finding someone who could encourage full participation by those in attendance and create the environment that would encourage frank and honest conversation about the exchange of ideas by all participants. The end result is "buy-in" by participants.

We also considered that we were initiating a process that would take time and effort throughout the year, not just in a "kickoff" weekend. An effective consultant is critical to help begin the process and instill in the participants a sense of enthusiasm and commitment to follow through on the steps identified at the outset. After all, real sweat equity is required to complete the agreed upon tasks, including establishing teams and recruiting team members to focus on key initiatives that will create measurable results.

Those familiar with strategic planning development will remember "SWOT" — Strengths, Weaknesses, Opportunities, and Threats — as the mechanism for evaluating internal and external considerations. Typically, most time is spent evaluating the negatives as defined by "weaknesses" and "threats." In essence, this approach looks at past problems and barriers which can stymie creative thinking and innovation.

Tony's approach was a little different. Called "SOAR" — Strengths, Opportunities, Aspirations and Results, the focus is on the desired future, building upon the organization's recognized capabilities. Focusing on the positive enhances creativity and possibility thinking, so more sustainable ideas are created and shared within the strategic planning process. This approach also establishes mechanisms for moving forward



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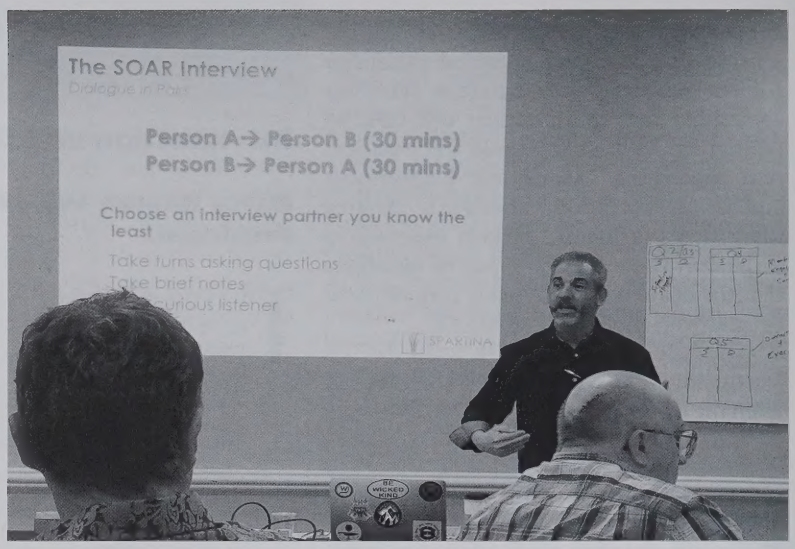

The SOAR Interview
Person A→ Person B (30 mins)
Person B→ Person A (30 mins)
Choose an interview partner you know the least
Take turns asking questions

Dave Jordan, AA4KN, all photos unless otherwise noted.

and the metrics for measuring the results to evaluate overall success, defined as follows:

Strengths: What are our greatest assets?

Opportunities: What can we improve, even innovate?

Aspirations: What is our preferred future?

Results: How do we know it; how do we see it? (measurable results)

AMSAT was fortunate to have an anonymous benefactor's donation to AMSAT cover Tony's consulting fee.

So, with our decision made to engage Spartina Consulting, a planning team was assembled in early February consisting of Keith Baker, KB1SF, Drew Glasbrenner, KO4MA, Paul Stoetzer, N8HM, and Clayton Coleman, W5PFG. Their goal was to work with Tony on developing the agenda for the two-day session and to ensure that key outcomes and topics were identified and shared with Tony in advance of the meeting. They also worked with Tony on developing the materials to be used by the participants during the two-day session in Orlando, Florida.

We started our first session on Saturday morning, March 4, 2017. The participants were:

- Barry Baines, WD4ASW, President and Board Member
- Keith Baker, KB1SF, Treasurer and former President
- Jerry Buxton, N0JY, VP-Engineering and Board Member
- Tom Clark, K3IO, Board Member and former President
- Clayton Coleman, W5PFG, Second Board Alternate
- Drew Glasbrenner, KO4MA, VP-Operations and Board Member
- Mark Hammond, N8MH, Board Member and former VP-Education Relations
- Joe Kornowski, KB6IGK, AMSAT Journal Editor
- Bob McGwier, N4HY, Board Member and former VP-Engineering
- Bruce Paige, KK5DO, Board Member
- Martha Saragovitz, Office Manager
- Gould Smith, WA4SXM, Former Board Member and former VP-User Services
- Joe Spier, K6WAO, VP-Educational Relations
- Paul Stoetzer, N8HM, Corporate Secretary and First Board Alternate
- Dave Taylor, W8AAS, ARISS International Delegate who filled in for Frank Bauer, KA3HDO, VP-Human Space Flight

We also invited Dave Jordan, AA4KN, to attend the sessions as our "scribe," responsible for capturing all of the thoughts/outcomes that were discussed, and ensuring that any ideas put into the "parking lot" were not lost. A significant amount of detail needed to be documented, and Dave spent two weeks after the meeting putting together a document for the participants to use as a reference of what transpired in Orlando. Our thanks to Dave for his diligence in documenting a very intense and fast-paced weekend of activity.

The AMSAT Strategy Kickoff Retreat Agenda outlined seven Desired Outcomes:

1. Conduct a SOAR Analysis (topics: member-driven/member engagement, communication, ownership and urgency in execution)
2. Develop a shared vision (consensus on direction)
3. Reach consensus on key goals/priorities
4. Clarify Value Proposition ("What's in it for Me"/WIFM or "Case for Support") from member, donor/sponsor and partner perspective
5. Develop a strategy roadmap (short, medium, and longer term actions, with milestones, responsible parties)
6. Create Board/leadership ownership (urgency for execution, motivated, excited), and
7. Agree on next steps (engage members, volunteers, partners/sponsors, etc.).

The morning began with an exercise in which attendees paired up to conduct a reciprocal SOAR (Strengths/Opportunities/Aspirations/ Results) interview. Each participant asked the other a series of questions developed by Tony and the Planning Team to encourage each team member to: become engaged in the overall process; share what has encouraged them to be part of AMSAT; and discuss how they view AMSAT's signature strengths and opportunities. This process became a personal experience, where each person described what "first drew you to AMSAT." Additionally, each participant was asked, for example, "Think about a highpoint experience, a time when you felt a sense of

pride and personal accomplishment and when you felt most effective and engaged. Please share your story. What happened? Who was involved? And what keeps you committed to the future of AMSAT?"

From this personal perspective, we then built upon having each interviewee identify AMSAT's 3-5 "signature strengths" based upon the interviewee's experiences with AMSAT. We then asked each interviewee what innovations, improvements, and changes AMSAT could implement to grow and be sustainable into the future.

Each response provided an avenue for each participant to tie his or her personal perspective into a wider context. Each was asked questions about strengths and opportunities about "Member Engagement and Communication," as well as "Ownership and Execution." Participants then were directed to consider a vision for AMSAT's future: "Three years from now what do you see happening now that is new, different and better (Aspirations) and What Results are we achieving and what impact are we having on our membership, volunteers, partners, and public?"

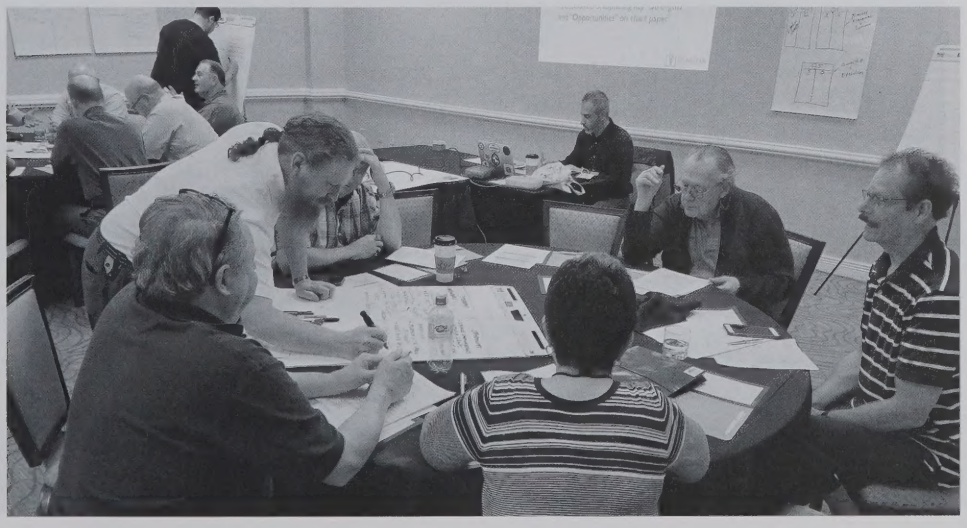
In the two-person exercise, each person who initially was the interviewee next became the interviewer of their partner, asking the same questions. The result was not only sharing of personal stories, but an opportunity to aggregate what was said by each into an overall summary for the areas of discussion. With 15 participants, plenty of comments resulted from each discussion area to recognize and incorporate into an overall sense for the team through a process of "theming." Two teams were subsequently created to review the responses given by members of that team through the interview process to identify key themes for Strengths and Opportunities identified in the interview process.

A large group discussion followed that looked at "Trends and Changes," focusing on those areas that will most positively impact AMSAT in the future. Next, three groups participated in a "Vision Activity" that identified key themes around Aspirations and Results with the intent of identifying a creative vision of the future. Each small group then shared its "creative vision" with the rest of the participants to convey a sense of possibilities for AMSAT in the future, such as in areas of membership engagement or services offered. Our focus was not necessarily on specific satellite projects, but rather on identifying organizational matters that impact membership and others who are "touched" by AMSAT.

Following lunch, participants focused on developing a consensus of goals/priorities based upon the visions shared earlier: "What's important to focus on?" Once those focus areas were identified, the participants were split into small teams with each team tasked with handling one of the identified focus areas. This included defining the goal area (success measures) and identifying key initiatives/activities for that goal area over the next 12 months, as well as the next 18-24 months, as appropriate.

As a result, four key areas of focus were identified:

1. Innovation in satellite products and services
2. Membership Engagement and Communication
3. Operational and Financial Excellence (which includes IT and web development as well as succession planning), and
4. Partnerships (Educational tied to goal 2, Technical tied to goal 1, and Financial tied to goal 3 revenue streams).



Each category has a team leader. Initial reports from the areas of focus are included below.

Sunday's activities started with a reflection on Day 1 and then a Day 2 Agenda Review. We focused the remainder of the morning on:

1. AMSAT's Value Proposition. This included an analysis of who our "customers" are (e.g., AMSAT members and Space and Radio Enthusiasts), the "pains" they encounter (such as dealing with the learning curve) and the "gains" achieved (successful outcomes such as telemetry collection, two-way contacts, involvement in satellite design and construction, etc.). We then discussed how AMSAT might lessen the pains and what positive gains would result.

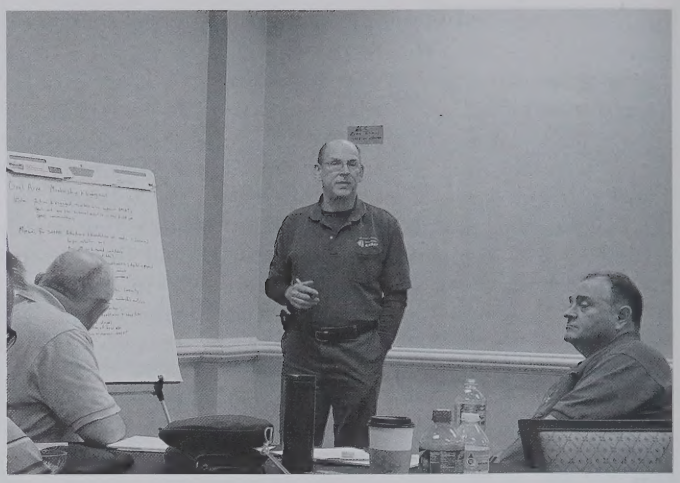
2. Developing strategy roadmaps. Each team focused on the four key areas, identified important milestones, timing, and responsible parties. In essence, each team scoped out what needed to be done in 2017 and 2018 to reach their goals, with results subsequently presented to the larger group. Having each team outline its expectations to the broader group provided an opportunity to identify potential overlap, as well as missing items and/or dependencies between goals. After lunch, we finished the process, identifying resources needed for success.

During the weekend, the team came up with both a Mission Statement and a Vision Statement:

***Mission**: To facilitate the design, assembly and launch of amateur satellites for use by licensed amateur radio operators and to provide an educational platform through the use of such devices for enhancing science, technology, engineering and math (STEM) initiatives for education.*

***Vision**: To continue innovation within the amateur radio hobby through means such as furthering our knowledge base by retaining and increasing membership and by seeking more liaison opportunities with higher education institutions. In addition, finding new channels for revenue through partnering with organizations sharing related interests.*

A key concern within strategic planning is the realization that a weekend spent defining opportunities and priorities is but the first step in accomplishing strategic goals. The real work takes place after the initial kickoff,



and a key determinant of success is not only the focus of strategic team leaders, but their success in building an implementation team with personnel focused on accomplishing their goals and spreading the workload. This work must be done in addition to the primary duties of our Senior Leadership Team, as well as whatever professional, family and other responsibilities our volunteers may have. In addition, making every effort to meet milestones is critical if we are to make a difference in 2017 and 2018.

Organizational and Financial Excellence Team Report

Keith Baker, KB1SF/VA3KSF Past President and Treasurer

The goal of this part of our new AMSAT strategy is to look for ways to improve the flow of work within the organization and develop an information technology (IT) structure that supports that workflow while also improving AMSAT's presence on the Internet for both prospective and current members. At present, our team exploring these ideas consists of myself, Keith Baker, KB1SF, our Vice President of Engineering Jerry Buxton, N0JY, and our Vice President of Educational Relations Joe Spier, K6WAO.

As AMSAT's current Treasurer, it's my job to advise the board of directors about the financial health of the organization and to recommend ways to keep the organization solvent both in the near term as well as "down the road."

I'm pleased to report that much of the work to improve AMSAT's Internet presence is already well underway with the hiring of an outside contractor who is now in the process of analyzing AMSAT'S current Internet offerings with an eye on how those products might be improved. There are also several initiatives underway to break the overall day-to-day management work of the organization into bite-sized pieces so as to possibly distribute some of the work that is currently being done at AMSAT Headquarters among AMSAT's volunteer base.

Along with that goal is an effort to look for ways to raise additional capital revenue for both organizational operations and future ground station development, as well as for satellite construction and launch.

Indeed, from the "raising capital" standpoint, for the last several years AMSAT has been operating in a financial environment whereby member dues alone are not sufficient to cover the overhead costs of running the organization. As a result, AMSAT's financial managers have had to increasingly rely on capital gains from our investments as well as from other donations just to "keep the doors open and the lights on." Clearly, such an approach to organizational solvency is fraught with risk and puts the organization's continued financial existence in jeopardy.

AMSAT needs to seriously explore other sources of revenue from outside of AMSAT (and perhaps even from outside Amateur Radio) so as to guarantee that AMSAT will have the financial resources in place to be able to fulfill its mission in the years ahead. At present, that part of our strategic planning effort is in a very early "What Ways Might We?" analysis stage of looking for alternate ways to raise additional capital. Some of the (not yet firm) ideas that are currently being explored include offering our experimenter's now proven engineering and other expertise in a consulting role to other organizations for a fee.

Another approach might involve offering plans and drawings, or possibly even assembling satellite "kits" of our Fox series of CubeSats, for purchase by organizations seeking to build a communication-based satellite. Such organizations may lack the necessary engineering expertise (such as thermal and electronic design) in-house to build their own satellites from the ground

up. And, yet another approach might entail casting a much wider net to see how AMSAT could benefit from crowd funding or other such philanthropic sources based on the work that we do and what we produce, particularly as it relates to K-12 and higher education.

In the near term, given that none of us current team members have the necessary skills or experience in capital fund raising, we are now looking to our volunteer membership to secure those skills. Specifically, we need the help of a person or persons who have experience in marketing and raising capital funds in a "non-profit" environment to join us in our effort.

However, if nobody with the necessary experience and/or skills "steps up to the plate" to assist us, we will be forced to hire outside assistance at considerable additional expense. In any case, we are aiming for our initial fund raising efforts to begin in mid-summer and to be well underway by year's end.

If anyone with the necessary skills and experience in this area wishes to volunteer their help, please drop me an e-mail note at **kb1sf@amsat.org**. Or you can call me at my U.S. cellular number at 810-300-3707.

Membership Engagement and Communication

Paul Stoetzer, N8HM Corporate Secretary and First Board Alternate Clayton Coleman, W5PFG Second Board Alternate

A critical area identified during the strategic planning process was the necessity of improving communication of AMSAT activities with the membership and amateur radio community at large. Several initiatives are underway or planned to improve these areas. Immediately after the strategic planning meeting, the AMSAT President's Apogee View column from the January/February *AMSAT Journal* was posted on the website. This column, featured at the beginning of each issue of *The AMSAT Journal*, provides the most comprehensive summary of AMSAT activities, and publishing it on the AMSAT website widens the distribution.

Second, the AMSAT website, online store, and membership database are currently undergoing a modernization project led by AMSAT IT Team Leader Joe Fitzgerald, KM1P, and an outside vendor. When completed, this will give AMSAT a modern web presence as well as a self-service system for updating membership information. This system will eventually allow an individual to join AMSAT, instantly receive a membership ID number, and gain access to members-only content. Additionally, members will be able to update their addresses and other information directly. In the future, this system will also allow for digital distribution of *The AMSAT Journal*.

Future initiatives include developing a strategy for closer coordination of social media and news distribution to ensure the widest possible audience for AMSAT news. Development of a defined process for volunteer onboarding was also identified as a need.

Innovation in Satellite Products and Services, Partnerships

Jerry Buxton, N0JY, VP Engineering

Our vision is to continue to push for more and higher LEO capability at the same time preparing for any P3, P4, and P5 opportunities that come from ASCENT development. We would also be ready to support any P3, P4, P5 opportunities from external sources (i.e., Virginia Tech).

In terms of partnerships, we plan to continue to support our key educational experiment partners in all of our satellite orbit opportunities and cultivate other educational experiment partnerships which provide mutually beneficial opportunities to the partner and AMSAT. In addition, we will seek to provide amateur radio systems for partners to fly on their own satellites as primary or backup communications, and support education in schools of all types by providing information, hardware, and support for CubeSat amateur radio systems.

AMSAT Journal Strategic Planning Reader Poll

A key part of the strategic planning process, as President Barry Baines explains in his article in this issue, is "member engagement." The reason is that, in a non-profit membership organization like AMSAT, the members quite simply are the lifeblood, the key stakeholders, or what a commercial enterprise would call "customers."

Member engagement can take many forms. In the strategic planning process, however, member engagement means helping AMSAT figure out how and where to find new and realistic opportunities to move the organization forward. To that end, *The AMSAT Journal* is asking for your help by "engaging" the AMSAT leadership with YOUR desires, needs and vision about the future direction of AMSAT by providing your best answers to the five questions below:

1. What are 3-5 new products, services or activities that AMSAT should START offering or doing (in order of priority, 1 being highest)?
2. What 3-5 current offerings or activities should AMSAT STOP offering or doing (in order of priority, 1 being highest)?
3. What are the top 3 ways that you would prefer AMSAT to communicate with you as a member (in order of priority) [e.g., email, social media (Facebook Twitter, Instagram, other), website, text, HF radio nets, etc.]?
4. If you were going to recruit another amateur radio operator as an AMSAT member, what pitch do you think would be most successful in making that ham want to join?
5. From your perspective, what would AMSAT ideally look like in 3 years? What would it be doing? What products and services would it offer?

We will share your answers with the AMSAT Board of Directors and members of the strategic planning team.

PLEASE EMAIL RESPONSES TO:
journal@amsat.org
SUBJECT: Reader Poll

Hamvention 2017

Joe Kornowski, KB6IGK
Editor

This year's Hamvention marked a number of "firsts" for all Hamventioners as well as AMSAT. Most attendees navigated unfamiliar routes to the Greene County Fairgrounds in Xenia, Ohio, about 23 miles southeast of the former venue at now-closed Hara Arena in Dayton.

The fairgrounds are located in a semi-rural area, which means driving on mostly two-lane roads instead of freeways and highways. Anticipating the traffic challenge, the Dayton Amateur Radio Association (DARA), in conjunction with the City of Xenia, implemented creative strategies to mitigate traffic congestion and delays. For example, DARA's operators on the talk-in frequency provided excellent directions and parking suggestions for travelers.

The convention layout extended over a large area, with multiple buildings for exhibits as well as forums, providing a less claustrophobic experience. In the larger outdoor areas between buildings, food and beverage carts provided much-needed hydration and energy in the Ohio humidity.

Another change brought AMSAT a substantially larger exhibit space in the first aisle next to the door in Building 1, with the outside satellite demonstration area directly behind the wall on the left side of the exhibit. The logistics could not have been better for both booth staff and visitors.

Joe Kornowski, KB6IGK, all photos unless otherwise noted.

A larger space for keeping amateur radio in space.

A bigger exhibit = more visitors, prospective members, and sales!

AMSAT Forum

AMSAT Vice President of Educational Relations, Joe Spier, K6WAO, kicked off this year's AMSAT Forum as moderator. Joe provided an overview of the agenda, and introduced President Barry Baines to provide an organizational update.

Barry Baines, President

Barry began his remarks by noting the upcoming AMSAT Board of Directors election. He stated that four members were

Partnerships Open Opportunities
The Fox-1 Program

Fox-1Cliff/1D Ready for Launch

- Virginia Tech Camera
- Penn State –Erie MEMS Gyro
- New MPPT Design
- Single Channel FM U/V Transponder with L/V capability
- Fox-1C includes ISDE (Vanderbilt University) Radiation Experiment
- Fox-1D includes University of Iowa's High Energy Radiation CubeSat Instrument (HERCI) radiation mapping experiment
- Fox-1C late 2017- early 2018 launch from Vandenberg (Falcon IX)
- Fox-1D late 2017 on Indian PSLV launch
  - -Spaceflight, Inc. responsible for integration/export control
- Fund Raising for Launch is ongoing-Please Support!

Partnerships Open Opportunities
The Fox-1 Program

RadFXSat/Fox-1B Designated for Launch

- Vanderbilt submitted CSLI Application in November 2012
- Mission Readiness Review completed 29 APR 17
- ELaNa-XIV-Currently scheduled No Earlier Than 20 SEP 17 (Delta II)

RadFXSat/Fox-1E Designated for Launch

- Vanderbilt submitted CSLI in November 2015
- Assigned to ELaNa-XX
- Current launch window No Earlier Than December 2017 (Virgin Galactic)

Partnerships Open Opportunities
FalconSAT-3 (FS-3)

- FalconSAT-3 developed by the US Air Force Academy (AFA) Space Systems Research Center (SSRC), built by cadets as an engineering learning activity and launched in March 2007
- After 10 years of service, FS-3 declared 'surplus' as the satellite completed its scientific & training mission and AFA SSRC redirects resources:
  - » FalconSat-6 set to launch this Fall by SpaceX
  - » FalconSat-8 currently under early stages of design/expected to launch in early 2019

Partnerships Open Opportunities
FalconSAT-3 (FS-3)

- Since March, AMSAT has been working with Jim White, WD0E (Colorado Satellite Systems) to arrange for AMSAT to gain "Operational Access" to FS-3
  - » Utilizes the Amateur Satellite Service Bands (UHF/VHF)
- Draft agreement between AFA & AMSAT is under final review
- Once agreement is signed by both parties, operational details will be publicly announced
- Expect historical information on FS-3 in a future AMSAT JOURNAL
- This is outstanding news for both amateur radio and AMSAT, reflecting AFA's desire for FS-3 to have a new comm mission as well as a willingness to collaborate with AMSAT

up for re-election this year and encouraged anyone interested in running for the board to get their nominations submitted.

Barry reminded the audience that AMSAT's purpose was to keep amateur radio in space. Turning to the update slides on the Fox satellite program, Barry asked the audience to pay particular attention to the partners that help open up opportunities for AMSAT. Among these partners, Barry noted that the U.S. Air Force Academy was in the process of turning over to AMSAT a satellite, FalconSat-3, that had been used for the academy's own purposes since 2007 and is now declared surplus. The agreement for operational use by AMSAT is close to completion. The signifance to AMSAT is not only gaining a new orbiting satellite for amateur radio use but also indicating the academy's willingness to collaborate with AMSAT.

Barry next addressed the ongoing strategic planning process, observing that AMSAT is at a crossroads and that the last time AMSAT adopted a strategic plan was in 2004. The process was kicked-off with a two-day session in Orlando. In this planning weekend, with the facilitation assistance of Tony Silbert of Spartina Consulting, the AMSAT leadership undertook a "SOAR" analysis — Strengths, Opportunities, Aspirations and Results. Barry noted the team also looked at key goals and outcomes, and come up with agreement on next steps.

Barry emphasized that it is not just the board that AMSAT is trying to engage in the process but others who can help AMSAT move forward, including the membership and people who we collaborate with.

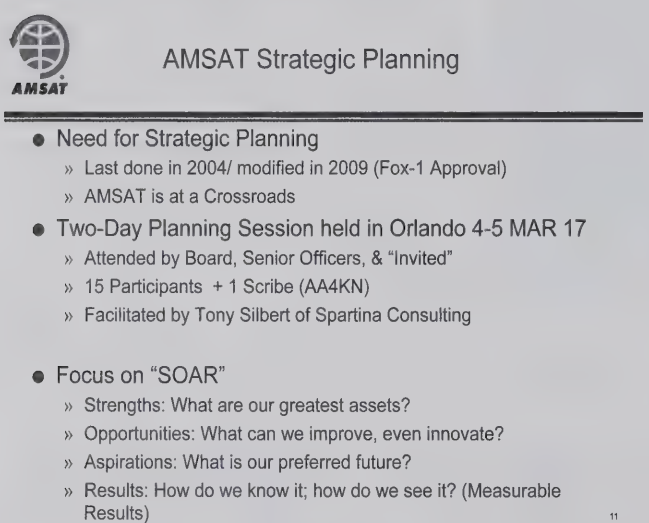
The four basic areas identified were:

1. innovation products and services
2. membership engagement and communication
3. operational and financial excellence, and
4. partnerships.

Each area has a team leader associated with it. They are identified in the accompanying slide. Under financial excellence, Barry called out the need to increase revenues, both for operations and for doing the projects we want to do.

Succession planning was another important criteria for determing the future success of AMSAT. Barry referred attendees to the website and *The AMSAT Journal* for updates as we move this process along this year.

While knowing where you are goingin strategic planning is important, Barry commented, so is knowing where you are. The slide on membership trends shows the numbers have gone down a little from 2016. While we did gain more life members this year, the overall numbers are not good in terms of supporting day to day operations. What that means is that we have to come up with funding to make up the shortfall, and those funds typically come from general donations or those specified to support operations. That is not a long-term solution, according to Barry. We have to boost the membership and find


AMSAT Strategic Planning
Need for Strategic Planning
» Last done in 2004/ modified in 2009 (Fox-1 Approval)
» AMSAT is at a Crossroads
Two-Day Planning Session held in Orlando 4-5 MAR 17
» Attended by Board, Senior Officers, & "Invited"
» 15 Participants + 1 Scribe (AA4KN)
» Facilitated by Tony Silbert of Spartina Consulting
Focus on "SOAR"
» Strengths: What are our greatest assets?
» Opportunities: What can we improve, even innovate?
» Aspirations: What is our preferred future?
» Results: How do we know it; how do we see it? (Measurable Results)
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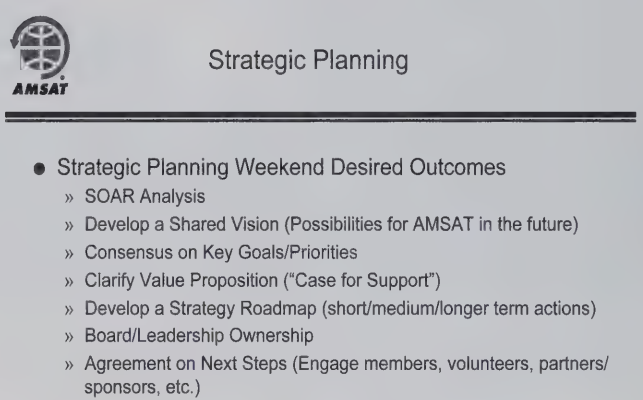
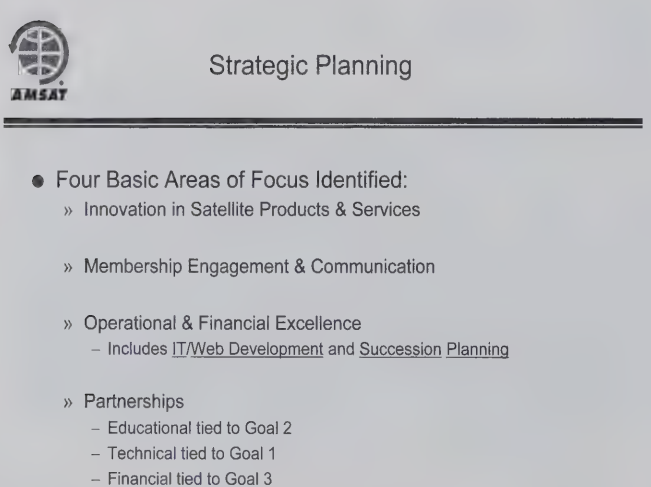
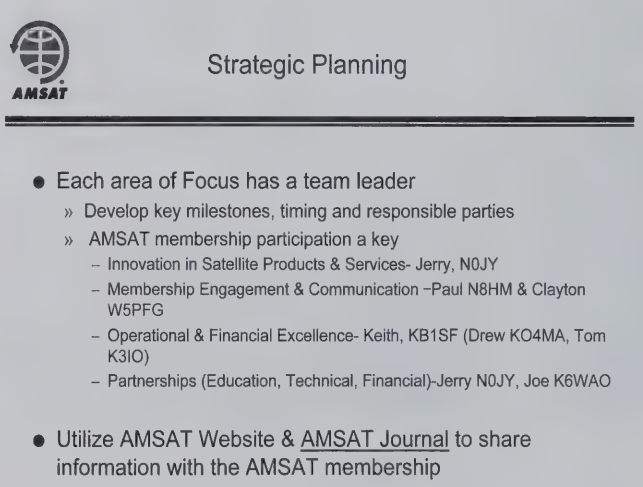

Strategic Planning
Strategic Planning Weekend Desired Outcomes
» SOAR Analysis
» Develop a Shared Vision (Possibilities for AMSAT in the future)
» Consensus on Key Goals/Priorities
» Clarify Value Proposition ("Case for Support")
» Develop a Strategy Roadmap (short/medium/longer term actions)
» Board/Leadership Ownership
» Agreement on Next Steps (Engage members, volunteers, partners/ sponsors, etc.)


Strategic Planning
Four Basic Areas of Focus Identified:
» Innovation in Satellite Products & Services
» Membership Engagement & Communication
» Operational & Financial Excellence
– Includes IT/Web Development and Succession Planning
» Partnerships
– Educational tied to Goal 2
– Technical tied to Goal 1
– Financial tied to Goal 3


Strategic Planning
Each area of Focus has a team leader
» Develop key milestones, timing and responsible parties
» AMSAT membership participation a key
– Innovation in Satellite Products & Services- Jerry, N0JY
– Membership Engagement & Communication –Paul N8HM & Clayton W5PFG
– Operational & Financial Excellence- Keith, KB1SF (Drew KO4MA, Tom K3IO)
– Partnerships (Education, Technical, Financial)-Jerry N0JY, Joe K6WAO
Utilize AMSAT Website & AMSAT Journal to share information with the AMSAT membership

AMSAT Organizational/Financial Trends Membership

- Membership Trends (US and Foreign)
  - » May 2017- 2997 (est. 1,639 non-life memberships) (LM2494)
  - » May 2016- 3177 (est. 1,740 non-life memberships) (LM2473)
  - » Dec 2014- 2992 (est. 1,682 non-life memberships)
  - » Dec 2013 - 3145
  - » Dec 2012 - 3698
  - » Nov 2011 - 3385
  - » Nov 2010 - 3660
  - » Nov 2009 - 3646
  - » Nov 2008 – 3501
- Continuing concern is that we need over 2,000 more members to meet operating expenses. Budget shortfall met by reallocation of resources.

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AMSAT Journal Editor Joe Kornowksi, KB6IGK

- Editor's focus:
  - » Magazine is published and distributed on time
  - » Enhance the quality by developing & implementing a style guide the establishes standards for the editorial staff to follow for content editing
  - » Develop a pool of materials by encouraging new members and AMSAT leaders to to submit articles and creating a pipeline whereby work on future issues is done in advance of expected publication dates
  - » Evaluate software tools to help the editorial team work more effectively together through collaborative editing
  - » Coordinate materials between various AMSAT media outlets
- Biggest Concerns?
  - » Develop a pool of articles/the "well" is getting dry
    - – Encourage members to share information/experiences
    - – Document significant events
    - – Spread the workload

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other revenue streams. We're not going out of business anytime soon, or next year, but the inability to sustain operations in the long term is not a good sign..

Barry moved on to talk about *The AMSAT Journal* because that's the tangible benefit people typically see as members. Barry noted that the *Journal* is published six times per year with Joe Kornowski as the Editor since January 2016. He's done a fantastic job — excellent production, getting it out on time.

Barry pointed out that the *Journal* is continually looking for material from members and others. And we're looking for a wide variety of ideas and subjects. If you've done a hamfest, you've been operating, or you've done something unusual from an operating point of view, or you're a "newbie," if you want to call yourself that, and you wnat to explain wht you've done or what you've gained over the years. We're looking for feature stories. We're looknig for human stories. We're looking for anything that would be relevant and important to share with our membership and with the satellite community in general. *The AMSAT Journal* is the premiere amateur radio satellite magazine out there right now, and the quality is dependent not only on the editorship Joe provides but providing the appropriate input and articles to make that such a stellar magazine.

Barry next challenged members to take on a bigger role than simply paying their dues. He referred to the list of things that members could help with.

Recruiting is the key that members can help with, Barry asserted, noting that the best way members can help is by word of mouth. He encouraged members to share their knowledge and experience of AMSAT with others.

Members can also help by donating above and beyond their membership dues. Clearly, the membership dues do not provide the funds necessary to build satellites like Fox-1Cliff and Fox-1D. We are paying Spaceflight for the cost of tthose two satellites. Also, the ground station terminal for "five-and-dime" is still going on. We also have the ARISS program which is critically important looking for funding.

Barry also encouraged members to use the existing satellites. Although we recognize that not all AMSAT members are satellite operators, but those who do have an interest please operate because one of the things that is important is to show the utilization of those satellites. Interest generates interest, so if you are a satellite operator, share the news about operating satellites. Barry noted that a satllite demonstration led by Paul Stoetzer was ongoing over the weekend right outside the AMSAT booth.

We need volunteers for technical support, engineering support, and operational support, Barry suggested.

Lastly, Barry encouraged the audience to attend the Space Symposium in Reno, Nevada, October 27-29.

How can AMSAT Members Help?

- Recruit individuals to become members/rebuild the 'base'
  - » Every 227 new members @ "base membership" brings $10K
  - » Higher membership base will provide greater funding support over time
- Recognize that satellite projects are multi-year projects that require financial support each year
- Donate to our capital campaign for Project Fox-1Cliff/D Launch and future opportunities in 2017 and beyond as you are able
  - » Membership dues are meant to keep the organization going
  - » Membership dues don't support our projects
  - » Ability to initiate new projects is dependent upon completing funding of prior projects
  - » Timing of new opportunities can lead to use of cash reserves which must be replenished to preserve the health of the organization

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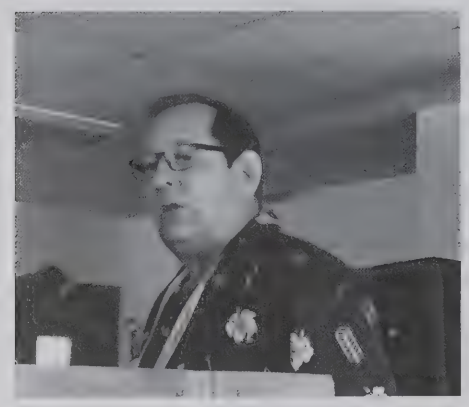
How can AMSAT Members Help?

- Use the existing satellites
  - » AO-85 launched on 8 OCT 15
  - » Drew, KO4MA will summarize current fleet availabilty
  - » Encourage use of the new satellites to be launched later this year
  - » Expand interest in amateur radio in space
- Write articles for the AMSAT JOURNAL
  - » Field Operations activities/outreach
  - » Personal stories/experiences/lessons learned from using the satellites
  - » Technical articles
  - » News Photos
  - » Journal editorial team will help polish your materials

Jerry Buxton, V. P. Engineering



Jerry began his remarks with a recap of the Fox series of satellites. He reported that everything on AO-85 was nominal, though it is "hard of hearing" because a last minute repair affected the tuning of the receive antenna. So, the idea of an Arrow with a 5 W HT is possible, but not as easy as we had hoped. The rest of the satellites, Jerry noted, are expected to be much better based on what was learned.

Over 2.5 million telemetry frames have been captured to date from hams all over the world, which is providing us a lot of wonderful data about the satellite, as well as the science for Vanderbilt, our partner on that satellite. The science is an important part of our mission, and helps us get the launches from NASA.

In terms of Fox-1B, RadFxSat, Jerry reported that the Mission Readiness Review received a conditional "ok," and delivery/integration was expected at the end of June, with launch scheduled no earlier than September 21, 2017.

Fox-1Cliff is likely to launch in early 2018 on a Spaceflight Industries SSO-A mission on a SpaceX Falcon 9 after having been delayed from an earlier Spaceflight launch date. The satellite will carry an AMSAT L/V experiment., as well as experiments from Vanderbilt, Virginia Tech and Penn State.

Fox-1D will likely launch through Spaceflight in the second half of the year on an Indian Space Research Organization PSLV mission. The payload will include experiments from the University of Iowa, Virginia Tech, Penn State and AMSAT.

Fox-1E, as an ELaNa mission, will launch from a Virgin Galactic Launcher One — from an aircraft out in the Mojave Desert — in December 2017. Jerry stated that he expects that date to slip a bit given that this is the first flight for Launcher One. The satellite will include a 30 kHz linear transponder (V/U) and a 1200 BPSK telemetry/science beacon.

Based on the Fox series, AMSAT is in a position to offer value to other potential partners, including the University of Washington, Caldwell High School and the University of California at Santa Cruz.

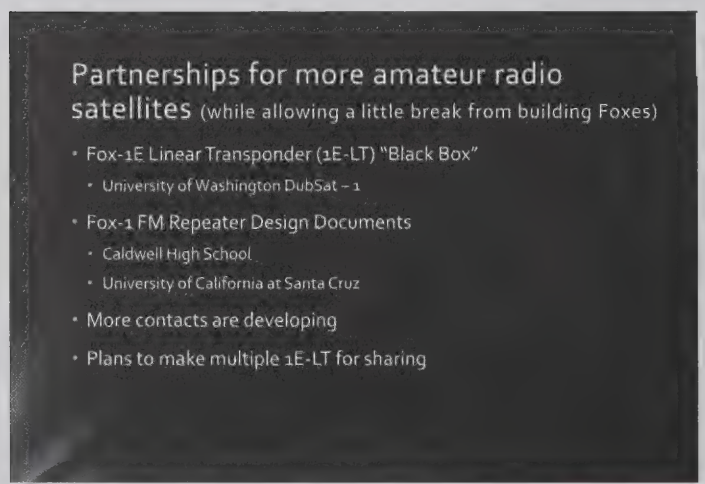
Jerry reported that, at the close of Fox, we're looking at what we are going to do for the next series of satellites. After we finish Fox-1E, we'll be getting together to do brainstorming sessions as we did for the Fox series. Our general thoughts at this point are to go with a 3U CubeSat because of more flexibility, more power, more room to carry experiments. And we're looking to get higher orbits. Most of the orbits offered are around 500 km. They last six to eight years depending on where they are launched. We want a bigger footprint higher up. So, that would be the "Golf" series following Fox — a higher orbit and larger footprint.

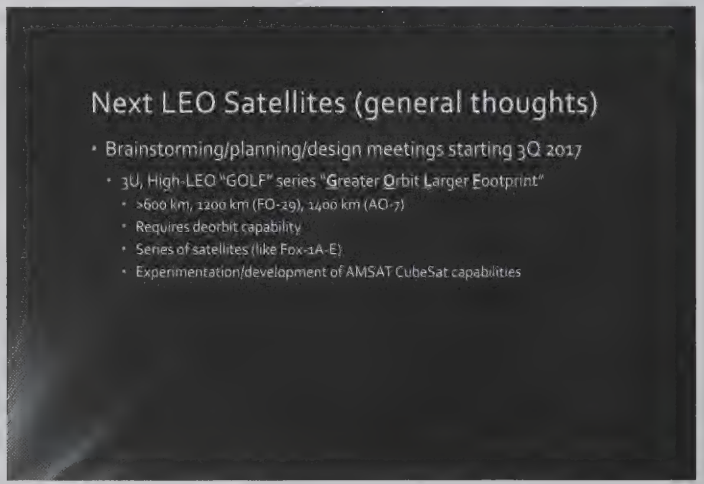
If we design for it, opportunities exist for orbits between 600 to 1200 km, and even 1400 km. That's the kind of coverage you get with FO-29 and AO-7. To do that, though, we have to be able to bring it back, to decommission, based on the 25-year requirement for end of mission. For orbital debris purposes, your satellite has to re-enter.

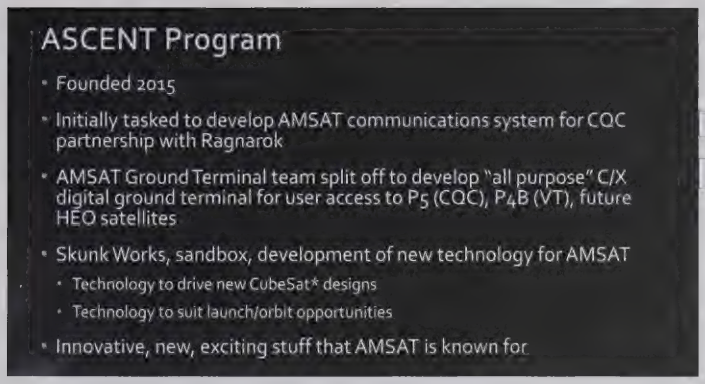
Jerry noted that AMSAT also expects to use 3U as a development platform for different technologies as we expand and move to HEO and other orbits. Looking towards what's going on behind the scenes with ASCENT, which was formed a couple of years ago, a group of engineers was initially tasked to develop the AMSAT communications system for the CubeSat Quest Challenge that NASA sponsored in partnership with Ragnarok. So, we've got a satellite going into lunar orbit that will carry amateur radio provided by us and that will be available as a transponder later.

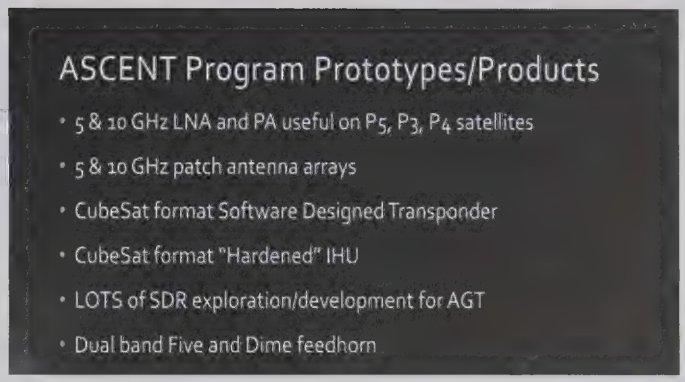
Jerry described the work of the AMSAT Ground Terminal team, which split off from the ASCENT team to develop an all-pupose digital ground terminal. Based on what was developed with the Phase 5, CQC, the team's work is designed to come up with satellites that have smaller antennas, as we move to microwaves, and to provide a station, plans for a station, or even an entirely manufactured station for everyone to use with these future satellites.

ASCENT is basically a skunkworks with the engineers playing around in a "sandbox." Whatever they develop helps drive what we can do or want to do future satellites. As we see what orbits or launch opportunities are


Partnerships for more amateur radio satellites (while allowing a little break from building Foxes)
• Fox-1E Linear Transponder (1E-LT) "Black Box"
• University of Washington DubSat – 1
• Fox-1 FM Repeater Design Documents
• Caldwell High School
• University of California at Santa Cruz
• More contacts are developing
• Plans to make multiple 1E-LT for sharing


Next LEO Satellites (general thoughts)
• Brainstorming/planning/design meetings starting 3Q 2017
• 3U, High-LEO "GOLF" series "Greater Orbit Larger Footprint"
• >600 km, 1200 km (FO-29), 1400 km (AO-7)
• Requires deorbit capability
• Series of satellites (like Fox-1A-E)
• Experimentation/development of AMSAT CubeSat capabilities


ASCENT Program
• Founded 2015
• Initially tasked to develop AMSAT communications system for CQC partnership with Ragnarok
• AMSAT Ground Terminal team split off to develop "all purpose" C/X digital ground terminal for user access to P5 (CQC), P4B (VT), future HEO satellites
• Skunk Works, sandbox, development of new technology for AMSAT
• Technology to drive new CubeSat* designs
• Technology to suit launch/orbit opportunities
• Innovative, new, exciting stuff that AMSAT is known for


ASCENT Program Prototypes/Products
• 5 & 10 GHz LNA and PA useful on P5, P3, P4 satellites
• 5 & 10 GHz patch antenna arrays
• CubeSat format Software Designed Transponder
• CubeSat format "Hardened" IHU
• LOTS of SDR exploration/development for AGT
• Dual band Five and Dime feedhorn

available, we can work to determine what is most useful for them.

On the Phase 5 and CQC, we will provide the communications and command link for the 5 and 10 GHz. They are going to orbit thte moon and send back data to try to win the prize. When they are done with that, the plan is to let us operate it as a P5 satellite for the rest of its life.

Jerry shared some of the things ASCENT has been producing: 5 and 10 GHz LNAs and PAs for the Phase 3, 4, and 5; 10 GHz patch antenna arrays; a CubeSat format (4" x 4") PCB system design for FPGA software designed transponder that could provide a variety of bands and modes on various satellites to be able to work; and a CubeSat format safety-tolerant IHU. As we go higher, especially where more radiation exists, and depending on what our mission is, this IHU would mitigate the kind of frequent resets we have had with the Fox series. ASCENT extensively has explored SDR, dual "five and dime" feedhorns, and what it takes to put together the AMSAT Ground Terminal.

Jerry urged those who are interested to volunteer because more volunteers help get more satellites developed faster. Opportunities on the team include the areas of de-orbit, ADAC, power, thermal, mechanical/spaceframe, and RF, among others. Additionally, the greatest risk in getting satellites launched and in orbit is the availability of volunteer time. Jerry emphasized the fun of producing a satellite and putting it into orbit.

Drew Glasbrenner, V. P. Operations

Drew started his report by polling the audience about how many had made a satellite contact in the past year. About a third raised their hands. The same number raised their hands when he asked about contacts made in the past month, with a couple having made a contact in the past week.

Drew shared that, with the right equipment, an operator currently could make contact with 17 satellites. In a place like Florida, Drew said that number is 19 because of two satellites with low inclination.

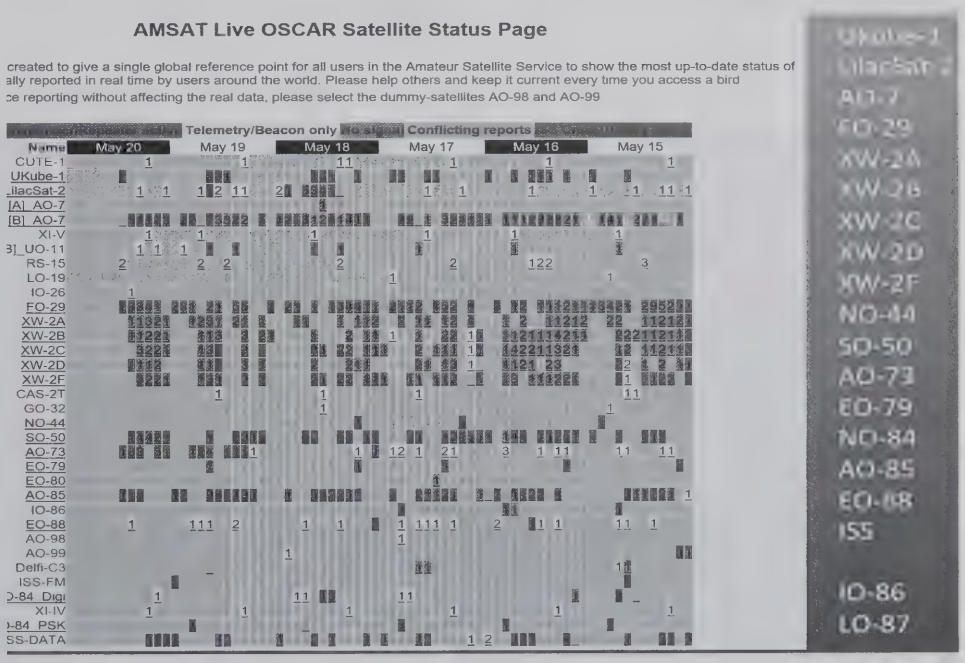
Drew showed the audience a screenshot of the AMSAT satellite status page from the AMSAT website (www.amsat.org/status/). New operators sometimes have a problem knowing when a satellite is on. Not all the satellites are on all the time because of change in schedule or changed modes. On the status page, clicking on the satellite name brings up a separate page with a lot of detail about that particular satellite. Every block in the chart represents a two-hour time slot. When that block is blue, it means that the satellite is operational. Yellow telemetry only. Red is not heard. Orange is conflicting reports. Purple indicates the ISS crew is making voice contacts. Drew noted that this is a great resource for anyone wanting to start making contacts.

Next, Drew provided an overview of currently operating satellites:

AO-7 — launched in 1974, died and came back to life, a great satellite 1450 km up in a great orbit; its old and easy to overload it. More than 5-10 W is too much power. This is probably not a satellite for beginners.

FO-29 continues to be a workhorse satellite because of its broad 100 kHz wide transponder. And the fact that its up at 1200 km gives it a nice footprint.

Some years ago, CAMSAT, our Chinese counterpart, launched a series of nine satellites, seven with transponders and repeaters on them. These are the XW



satellites, 2A through 2F, as well as LilacSat-2 (see the right column on the image below). These satellites are 70 cm up, 2 m down. They have 20 kHz wide transponders. They are very strong satellites, though they are somewhat low. What's really neat is that they come over in a line. So, you can work one, and then a couple of minutes later you can work the next one, with the next one a couple of minutes later. That makes it convenient if you want to take an afternoon, early evening, or early morning, and work satellites for a solid hour.

NO-44 is still kicking on some passes when illumination is good. It's a packet satellite, 145.825 MHz digipeater.

SO-50 is our workhorse FM repeater satellite. It's been up quite awhile. It's not the easiest to hear, but it is easy to get into and sees the most activity.

AO-73, EO-79 and EO-88 and Ukube-1 are all FUNcube transponders from AMSAT-UK. They all have various schedules and quirks. They work great but have individual personalities, and sometimes they are on and sometimes not. Drew encouraged everyone to go to each description on the webpage to learn more about them.

The digipeater on ISS is back on 2 m and working well. NO-84 also has a digipeater on 145.825 MHz and a PSK31 transponder, 10 m up and 70 cm down. IO-86 is great if you live south of Florida or north of Uruguay. It is a low inclination satellite launched by the Indonesians a few years ago, with a FM repeater and APRS digipeater. If you live in southern parts of Texas or Florida, you might have a shot at working it.

LO-87 is from AMSAT Argentina. Unfortunately, it only is activated over South America and Europe. Drew showed the audience a screenshot of the dropdown menu under Satellite Info on the amsat.org website in describing what kind of information is available. Drew next turned his focus to a discussion of what's coming.

Drew noted the upcoming deployment of LilacSat-1 from ISS [deployed May 25], as part of the QB50 scientific project of 50 satellites. LilacSat-1 includes an FM-to-Codec-2 transponder. It will listen to multiple FM frequencies on the uplink, put them together, sum the audios and send it down on the Codec-2 downlink. It also has an APRS digipeater and a camera. It is a low satellite but should be fun.

CAS-4A and -4B are from CAMSAT in China — transponder packages just like the XW-2 satellites. The coordination for these said that it would be a March 31 launch, but we have not seen it yet. Knowing launch dates is difficult, and we don't usually hear about it until the day before or day after. These will be transponder satellites in a 42-degree inclination orbit, so it will offer more west to east passes in the U.S.

JY1SAT is another FUNcube type project, scheduled to launch in the first quarter of next year as part of a SpaceX launch. The satellite will include a FUNcube style transponder along with a digital slowscan downlink.

K2SAT is from the Republic of Korea Air Force Academy. Its secondary mission is a V/U FM repeater. K2SAT is a 3U CubeSat. It apparently is supposed to launch from the H2 rocket in Japan in 2018.

ESEO is a student built satellite, with AMSAT-UK providing an amateur radio payload using an L-band uplink and VHF downlink. Providing a L/V FM repeater, it also will include the standard 1.2k BPSK telemetry, as well as a high-speed telemetry mode at 4800. That should launch at the end of this year or beginning of next year.

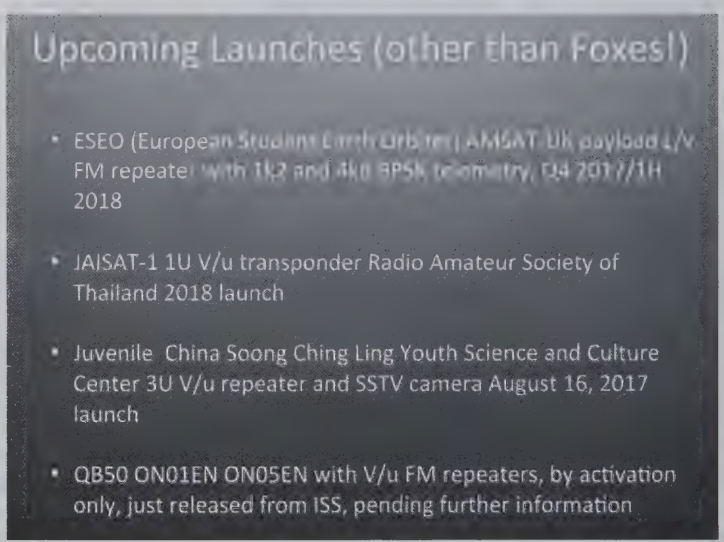
JSAT-1 is from the Amateur Radio Society of Thailand. It is a 1U satellite with a V/U repeater, like FO-29 but only 30 kHz wide. It is expected to launch in 2018. Another new one is called Juvenile and is from a group in China. It is a 3U satellite with a V/U FM repeater and a slowscan downlink where the user can send a command to take a photo and downlink it.

Just recently, two new satellites were released as part of QB50 and have V/U FM repeaters. So, a lot is happening. Check the website, ANS, the AMSAT bulletin board, Facebook and Twitter for updates. We'll try to get the information out as soon as it becomes available.

FalconSat-3, which Barry talked about, is very similar in parts to AO-51. Originally a 560 km orbit, 35 degree inclination, it now is down to 468 and 480-something km now. But we've still got several years before re-entry so we'll get some good use out of it.

Its going to operate as a V/U store-and-forward PACSAT. It's running at 9600 baud. We haven't had a PACSAT since AO-51 ceased operation, so it will interesting to have this option back again. As of now, it will sustain a 1 W downlink making it very easy to hear. That opens up some options for less than base station style operation.

Upcoming Launches (other than Foxes!)
• LilacSat-1 QB50 deployment from ISS with V/u FM to Codec 2 BPSK transponder, APRS digi, and camera May 25, 2017
• CAS-4A and -4B U/v linear transponders on larger host spacecraft, coordinated for March 31, 2017, 524km, 42 degree inclination
• JY1SAT Funcube-style U/v and SSDV image downlink Q1 2018 SpaceX launch
• K2SAT 3U cubesat from ROK Air Force Academy with V/u FM repeater 2018 H2 launch from Japan


Upcoming Launches (other than Foxes!)
• ESEO (European Student Earth Orbiter) AMSAT UK payload L/v FM repeater with 1k2 and 4k8 BPSK telemetry, Q4 2017/1H 2018
• JAISAT-1 1U V/u transponder Radio Amateur Society of Thailand 2018 launch
• Juvenile China Soong Ching Ling Youth Science and Culture Center 3U V/u repeater and SSTV camera August 16, 2017 launch
• QB50 ON01EN ON05EN with V/u FM repeaters, by activation only, just released from ISS, pending further information

OK, Why is Education Really, REALLY Important to AMSAT?

- The "sticker price" for a commercial CubeSat launch is $70k-150k per 1 Unit, and much more for an AO-51 class satellite. There is much less interest in government or corporate subsidies.
- Education is quickly becoming critical for our (free!) rides to space!

AMSAT's *Fox Family* CubeSat Strategy

- Take advantage of large and growing interest in CubeSats
- Develop family of CubeSats that would be attractive for flying science missions
- *Partner with universities and apply for free launches as science missions*
- After/during science mission, satellite runs amateur radio transponder
- "An OSCAR in Every CubeSat"

Drew advised that he and Mark Hammond were still learning all about it and that he was resurrecting his 9600 baud station to be able to control everything. The low inclination orbit is 35 degrees, and the passes are not what you typically would expect out of an amateur radio satellite. It's a big satellite!

The footprint is somewhere between ISS and one of the XW satellites, capable of coast-to-coast coverage. That really doesn't matter because it uses store-and-forward. You can upload a message and have someone in Taiwan reply to it.

All the passes go from west to east. If you are north of Virginia or in northern California, you antenna is always going to be pointing towards the south. Drew advised that if for operators who live down in Florida like he does, typical passes would be 0600 UTC, 0800 UTC, 1000 UTC, 12, 14, 16 — they all come in a row.

Drew lastly noted the work of the SatNOGS group, which is a bunch of guys who work with AMSAT and have put together a ground station network that collects telemetry from CubeSats and forwards it to a central server.

Joe Spier, V. P. Educational Relations

Joe began his remarks by showing a slide illustrating what it costs to launch more and higher satellites:

- P3E to GTO - $10M
- Small Sat to LEO - $3M
- ARISSat to ISS - $1M [ARISSat-1 was a freebie}
- Microsat to LEO - $500K
- 3U CubeSat to LEO - $300K
- 1U CubeSat to LEO - $100K (10 cm on a side, less than 1.33kg)

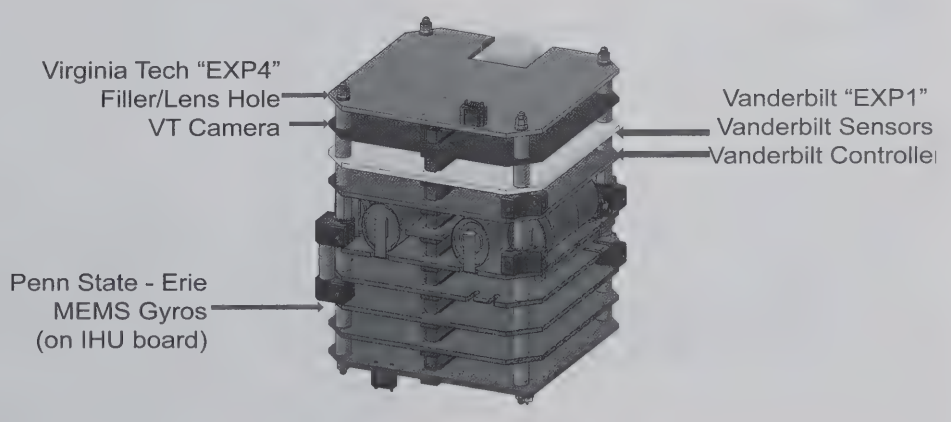
The only way for AMSAT to take advantage of free CubeSat launches under the NASA ELaNa program is for payloads to contain educational packages from university partners that qualify as science missions. AMSAT specifically partners with educational institutions involved in space education.

Joe explained that the science in AMSAT missions involving transponders is with the telemetry transmitted through Data Under Voice (DUV). To get that telemetry down, Joe explained, you need to get the science up there. That's where the educational component comes in.

Education is how we get the free rides — that STEM component. Our strategy is to take the Fox series satellites and make sure that, first, there was an OSCAR in every CubeSat launched and, second, partner with the universities so we don't have to pay for those launches each time.

To get a CubeSat to space costs $125,000 for a 1U. Joe showed a slide depicting the slots reserved for experiments by Virginia Tech, Vanderbilt and Penn State on Fox-1C. Joe showed the audience another slide with a photo of the Virginia Tech camera card. The next Fox series, Fox-2, offers the possibility for higher orbits, and larger CubeSates — 3U, and possibly 6U or 12U.

University Experiment Payloads on Fox-1C



Joe talked about AO-85's attitude control, with its passive magneticc stabilization system — a bar magnet that keeps the satellite oriented. It aligns the satellite's z-axis with the Earth's magneticc field. The initial data from the MEMS gyros shows that the stabilization for the spin is working quite well. But we identified some problems.

Last year, Joe said, he asked the question, "Who had a crystal radio set?" Crystal radios are what we got stated with for shortwave listening. Joe asked the audience, "What is today's crystal radio?" Joe said, it better be digital and either about robotics, space or some sort of programming. And it better have an app.

So, we came up with a solution to try to get into schools to see how we could get more telemetry information so we can figure out some of the Z-axis MEMS gyros issues we identified with the AO-85 CubeSat.

Joe shared that we came up with NxtGen Crystal Radio, which costs about $150. It consists of a RTL-SDR, a nice $20 SDR dongle that can be used as a satellite receiving station if you set it up right with the pre-amps created for the SDR from JaniLabs, An EZ-Lindenblad Antenna, with right-hand circular polarization, it is a great antenna for telemetry. And we ported the software for the SDR into the Fox telemetry software. Cost is $150 per kit, Joe stated, and gave 10 of them away yesterday.

Joe showed the JaniLabs pre-amp for $20. The cost of the SDR is proportional to the fidelity of the receiver. Lower costs can mean a higher noise floor. So, don't expect great results, but you will be able to get results.

Next, Joe explained how he came up with the Lindenblad antenna. It seems the form factor of an eggbeater antenna proved too large for classrooms. After trying others, Joe settled on the Lindenblad — a design from the 1930s, an old airport antenna. It works well with about 3 dB gain up to about 30 degrees inclination, then unity gain above that. And I can fit it all in a 36 inch by 3 inch mailing tube.

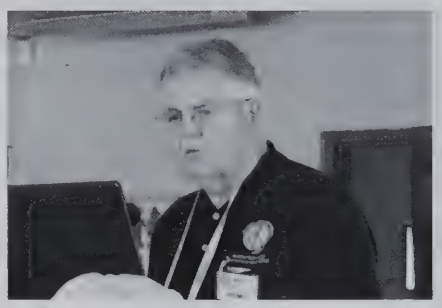
Joe explained how the SDR software was connected to the Fox telemetry software — so, we have an inexpensive receiver that ports to the telemetry software. We can even change the tuning for different satellites, Joe said. So, we've developed a very inexpensive ground station. With Data Under Voice, our telemetry that comes in is under 300 Hz, and additional telemetry ground stations, the additional data could help figure out the the anomaly we are seeing. As Douglas Quagliana, KA2UPW/5 wrote: "One man's voice is another man's telemetry."

So, can we make a contribution to the CubeSat community by discovering the problem identified with the MEMS gyro? Is it the "YORP effect" [variations in albedo across the surface of a small body in space could increase its rotation rate]? Or is it an instrumentation or something even worse, a TLE component called the "K factor" — atmospheric drag on the ionosphere? So, that's our goal with getting telemetry from NxtGen Crystal Radio.

Joe explained that the next phase would be a LimeSDR. You could build a 70 cm Lindenblad antenna with a LimeSDR with 150 mW that you can transmit on. So, that's our goal for the SDRs and the next generation of crystal radio.

Joe indicated that the next project for education will be launching a "toaster" — a CubeSat with a rocket engine, acceleromters, APRS radio package, video cameras, and a lot of impact sites in the Nevada desert — to see if we can do some science with that.

Tim Bosma, Trustee, W6SRJ, ARISS Ground Station



Tim began by talking about some of ARISS' sponsors:

- NASA Space Communications and Navigation (SCaN) is the primary sponsor.
- The Center for the Advancement of Science in Space (CASIS) runs the national laboratory on the International Space Station. Tim indicated that ARISS has an excellent relationship with them. One of their educational managers is a ham and is at the convention.
- Tim said that the ARRL has been a great supporter of ours — and AMSAT, too — for operations on the space station.

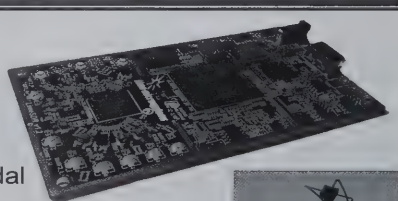
Tim observed that many people don't know that one of ARISS' objectives is as a backup radio station. The thing he said he is focused on is the STEM education of students. One of the goals is to get these kids, in middle school especially, interested in space, science,

NxtGen Crystal Radio

NxtGen Crystal Radio

- AMSAT Satellite Ground Receiving Station
  - » RTL-SDR
  - » JaniLabs RTL PreAMP
  - » EZ-Lindenblad Antenna
  - » FOXTelem Software
  - » Total Cost = $150 each

- Experimentation
  - » YORP Effect
- Antenna Designs
  - » Quadrifilar Helicoidal
- EXCEL Data
- NASA GMAT
- LimeSDR



technology and ham radio.

We are in the space station is, of course. We have the Ericsson radio on the Columbus Module. And the Service Module is where the Kenwood radio is located. One of the issues that we have is that the Service Module is a 28 V DC system, whereas the rest of the ISS is 120 V DC system. So, when you send a radio up with a specific power supply, it's usually specific to only part of the space station.

Some of the on-orbit capabilities include the VHF APRS packet, and VHF and UHF slow-scan. Tim identified a number of notable astronauts who have been involved in ARISS, including Sergei Krikalev, Bill McArthur, Frank Culbertson and Tim Peake. Tim just finished an outstanding STEM program with the U.K. schools, called the Principia mission — an excellent outreach program to 10 different schools. They did television with the new HamTV at the same time that they did voice contacts with those schools.

Bosma next turned to ARISS' organizational accomplishments. It's been 20 years since we had the first ARISS International meeting with international partners in November 1996. We had a very successful anniversary meeting this past November working out a number of MOUs and agreements, and planning for the next 20 years.

Tim referred to the slide listing ARISS' key accomplishments over the last 20 years.

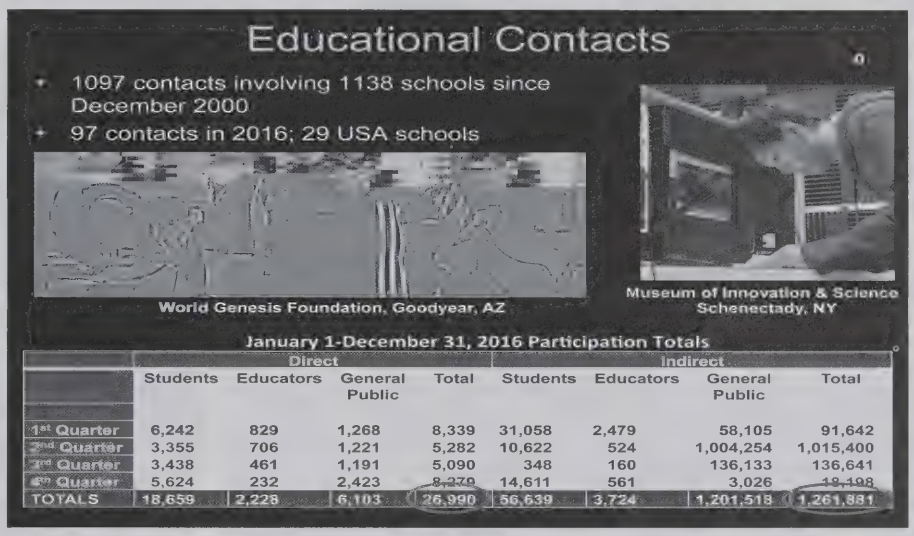
I think the most fun was probably the "SuitSat," where we took a used Russian orlon suit, stuffed a radio in it, and shoved it out the hatch.

Tim also advised that ARISS had put together an annual report that is extremely important for ARISS and its funding. The documentation to get funding to support operations is critical. This is one of the ways that we do that, said Tim.

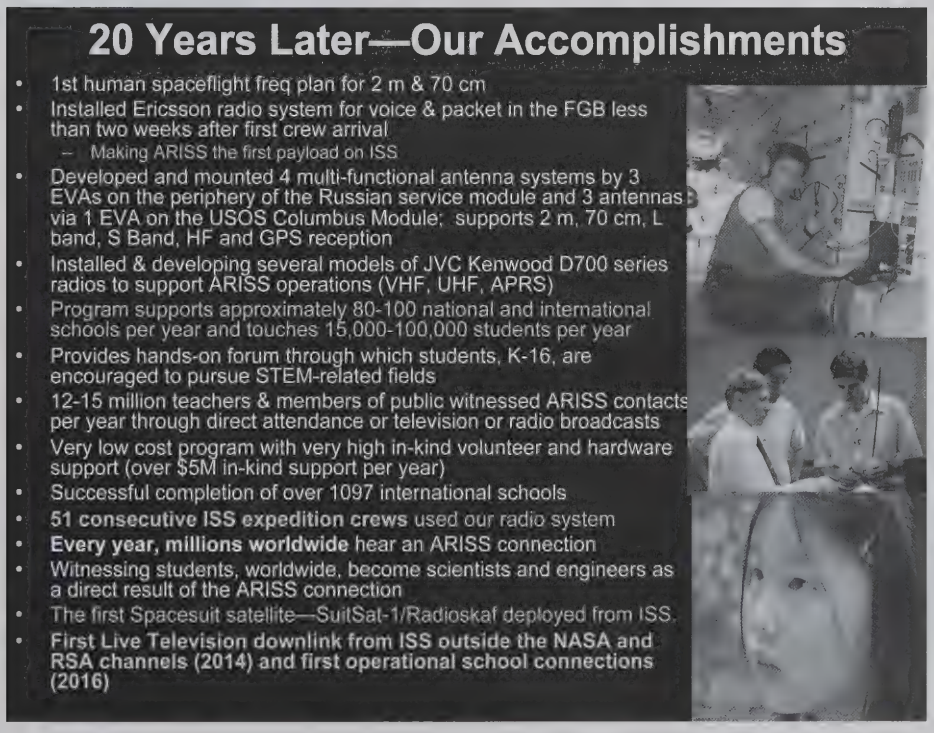
Tim reported that one unfortunate event this past year was the departure of Debra Johnson from the ARRL. As the ARISS-U.S. Education Lead, she was a key support person for NASA and ARISS education. While we have temporarily assigned her duties to Rosalie White, Tim explained, this has put a heavy burden on the existing staff. If you are into education and amateur radio or AMSAT, we could really use your help in this area.

In terms of operational accomplishments, Tim pointed to the slide that indicated a number of the contacts and the participation by the people that we've reached.

At this point, we've got over a thousand contacts in 54 countries. Of course, we see more contacts in specific countries if one of that country's astronauts is active on the space station. While the U.S. and Russia lead in the number of contacts, we saw quite a few contacts with U.K. schools during Tim Peake's mission and a number of contacts in France with Thomas Pesquet's current mission. It makes a difference when the radio communications occur in the native language.


Educational Contacts
1097 contacts involving 1138 schools since December 2000
97 contacts in 2016; 29 USA schools
World Genesis Foundation, Goodyear, AZ
Museum of Innovation & Science Schenectady, NY
January 1-December 31, 2016 Participation Totals

	Direct				Indirect			
	Students	Educators	General Public	Total	Students	Educators	General Public	Total
1st Quarter	6,242	829	1,268	8,339	31,058	2,479	58,105	91,642
2nd Quarter	3,355	706	1,221	5,282	10,622	524	1,004,254	1,015,400
3rd Quarter	3,438	461	1,191	5,090	348	160	136,133	136,641
4th Quarter	5,624	232	2,423	8,279	14,611	561	3,026	18,198
TOTALS	18,659	2,228	6,103	26,990	56,639	3,724	1,201,518	1,261,881


20 Years Later—Our Accomplishments
1st human spaceflight freq plan for 2 m & 70 cm
Installed Ericsson radio system for voice & packet in the FGB less than two weeks after first crew arrival
– Making ARISS the first payload on ISS
Developed and mounted 4 multi-functional antenna systems by 3 EVAs on the periphery of the Russian service module and 3 antennas via 1 EVA on the USOS Columbus Module; supports 2 m, 70 cm, L band, S Band, HF and GPS reception
Installed & developing several models of JVC Kenwood D700 series radios to support ARISS operations (VHF, UHF, APRS)
Program supports approximately 80-100 national and international schools per year and touches 15,000-100,000 students per year
Provides hands-on forum through which students, K-16, are encouraged to pursue STEM-related fields
12-15 million teachers & members of public witnessed ARISS contacts per year through direct attendance or television or radio broadcasts
Very low cost program with very high in-kind volunteer and hardware support (over $5M in-kind support per year)
Successful completion of over 1097 international schools
51 consecutive ISS expedition crews used our radio system
Every year, millions worldwide hear an ARISS connection
Witnessing students, worldwide, become scientists and engineers as a direct result of the ARISS connection
The first Spacesuit satellite—SuitSat-1/Radioskaf deployed from ISS.
First Live Television downlink from ISS outside the NASA and RSA channels (2014) and first operational school connections (2016)

Tim next focused on HamTV as the next significant system coming up. Lou McFadin, W5DID has been working on that. One of the resources we're needing right now is volunteer ground stations. We want to put a chain of stations across the U.S. so that as a HamTV pass goes across the country during a contact, we can download the video and extend it for more than a 10-minute pass.

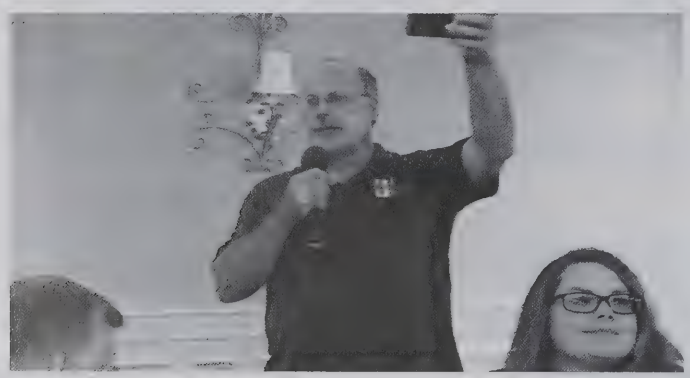
In terms of hardware, Tim explained that the older Ericsson VHF radio that was in the Columbus Module failed last October. We put a new one up, and there are some challenges with that. Tim referred attendees to the ARISS booth to see the new interoperable power supply and the new Kenwood radios in any of the modules. He concluded by encouraging attendees to help support ARISS financially and as volunteers.

Sat Demos, TAPR Dinner

Arrow antenna with rotor in demonstration area.

AMSAT satellite demonstration area. [All photos Joe Kornowski, KB6IGK.]

Paul Stoetzer, N8HM, and Doug Papay, KD8CAO.



TAPR President Steve Bible, N7HPR.

Carl Laufer, keynote speaker.

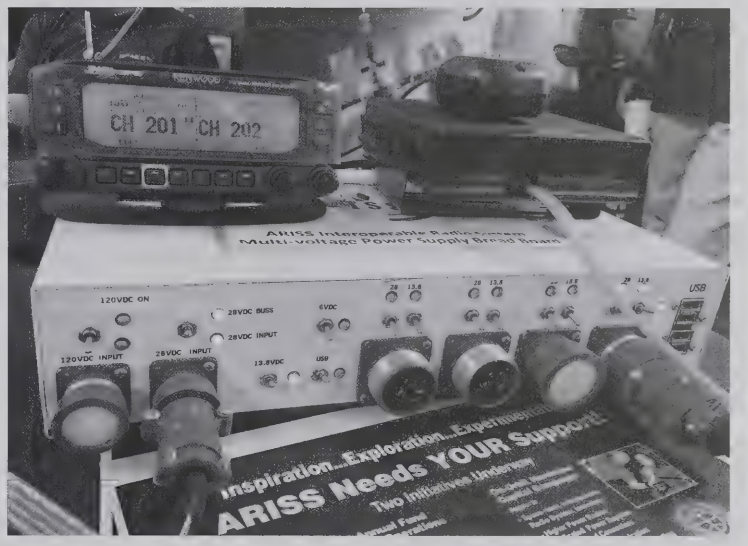
AMSAT President Barry Baines, WD4ASW.

ARISS, Frank Bauer Award

Dave Taylor, W8AAS, and Lou McFadin, W5DID. [Joe Kornowski, KB6IGK, photo.]

Special Hamvention 2017 ARISS Challenge Coin. [Joe Kornowski, KB6IGK, photo.]

Frank Bauer, KA3HDO, awarded 2017 Dayton Hamvention Amateur of the Year Award by Frank J. Beafore, WS8B. [Bob Inderbitzen, NQ1R, photo.]



Interoperable power supply with modified Kenwood DM-710G radio. [Joe Kornowski, KB6IGK, photo.]

(from left) Frank J. Beafore, WS8B, Barry Baines, WD4ASW, Frank Bauer, KA3HDO, and Dan Barstow, KA1ARD, Education Lead, CASIS. [Bob Inderbitzen, NQ1R, photo.]

Frank Bauer and family. [Bob Inderbitzen, NQ1R, photo.]

Setting the ISS UHF Distance Record

Jerry L. Rogers, W8LR

From the age of 11 years old, I have always been fascinated with shortwave radio and listening to radio stations from as far away as I could hear. In 1982, after finally getting over the fear of learning Morse code, I received my first amateur radio callsign, and the world I had so intently listened to as a young boy now became the world that I could actually talk to as well. Doing so, however, took room for antennas. So, antennas became a part of every home I lived in, until a few months ago when family care issues required that I move into a covenant antenna restricted community. So, my days as an avid DXer came to an end — well, sort of came to an end.

After researching how I could feed my desire for working DX, I found that DMR radio and satellite work could expand my severely compromised situation for antennas. When I was first licensed, I did work some of the older amateur radio satellites that had VHF/HF capability, but that was more of a "yeah I have done that, but I don't really care for it" kind of thing. So now, being totally restricted, my interest has returned to using satellites to fill my need to work DX.

Though I cannot put up a satellite array, I became fascinated with the possibility of "working the birds" again, and especially the "BIG bird," the International Space Station (ISS). From the time that amateur radio was flown into space aboard the ISS, I have wanted to make a contact with the ISS and talk with one of the astronauts or cosmonauts (still trying to get that contact). Having used packet as a HF DXer for DX spotting, I began to investigate the use of APRS that was available aboard the ISS. After seeing displays at the Dayton Hamvention last year and reading some of the articles in *The AMSAT Journal*, my desire to accomplish a goal of at least getting a contact with the ISS was renewed, and really became a mission to complete after knowing I was going to move into an antenna restricted community.

My Plan

While at the Dayton Hamvention last year, and knowing that I was going to lose my antenna farm, I began looking at transceivers that I could use from my car that would allow me to at least be mobile. That seemed like a pretty good thing to do, and then I could be a rover in some of the VHF contests and get back into UHF/VHF, and some HF work as well. That idea was short-lived when the XYL said she really was not too keen on having an SUV sitting in the driveway with all manner of metal sticking out from it like a porcupine. OK, so plan B! Plan B was to get a VHF/UHF handheld, and a portable handheld Yagi and focus on getting that contact with the ISS.

Plan B became a reality. I found a used Kenwood TH-D72A that, from what I understood about APRS, was a good little rig to use. I then decided to get the Arrow 146/437-14 that gave me 10 elements on UHF and 4 elements on VHF. Given that I was only going to be running 5 W or less, I felt I needed that extra gain the antenna offered.

After making a few APRS contacts locally, I thought it time to try and work the BIG bird. Getting all of the pass prediction software loaded up into the PC and the rig programmed, I was off on my quest. My initial attempt lasted about 10 minutes and resulted in no contact, but I did decode the RS0ISS beacon. After some thinking about the failure of making contact, I realized that I had not taken into account the Doppler shift of the signal. Having been in multiple VHF/UHF contest teams, I was familiar with the VHF/UHF propagation, but the Doppler effect was something new to me and, honestly, not considered very seriously when I programmed the rig.

After doing some more reading, including posts by Patrick, WD9EWK, I used his chart of frequencies to help program the rig for the UHF frequencies that the ISS then used for packet (the ISS packet/APRS frequency now has reverted to VHF). When I started listening to the ISS, it had already switched over to the UHF rig because of the failure of the VHF rig that had been in operation for many years. So, I owe thanks and gratitude to WD9EWK for helping me get started successfully working the ISS, though he never knew he had done so.

After a week of getting used to the Doppler shift on UHF and how the ISS sounded when it was in different positions in the passes, along with learning how to compensate for the change in polarization, my thoughts returned to making that contact with the ISS that I had wanted to make for so many years. Making contact with the ISS APRS system did not take me long, and I was so excited that I had accomplished a long time goal and desire. My thoughts next turned back to DXing.

DXing via the ISS was an intriguing thought to me. I know that all satellites have "footprints." And just like HF, if you don't have the propagation footprint, you won't be making any contacts. So, how do you DX the ISS? That is easy to answer but not an easy thing to do; find another station at the edge of the footprint with a window of time just long enough to make contact with the other station.

After a few weeks of making contacts from the Midwest and East Coast to the Southwest, I would occasionally see, only for a minute, a beacon from Dave Thomson, VA7THO. Although I had never worked him, I thought I would try to do so. After many attempts of waiting to see his beacon and never being on when he was, I thought I would ask him to schedule an attempted contact. I learned, after looking at the amsat.org website, that if VA7THO and I could make contact, it would be a new ISS UHF digipeater distance record.

When I contacted Dave, I asked him if he would be interested in trying to set a new record. I was so excited about doing some DXing and setting a record that I just bypassed the courteous request for a simple contact. I seriously thought that he would politely say, "No, but thanks for asking," as not everyone is as hooked on DXing as I am. However, I was totally shocked when, in February, I got a reply email from him saying he would be excited to participate.

Over the next six weeks, we both looked over charts for shared passes that would accommodate directions and elevations that were conducive for each of us, yet allow us to "see" each other via the ISS. Those six weeks preceding the contact were filled with multiple failures, finding new sites to work from, and late hours on work nights to go to a site only to be greeted by failure. However, we were not going to let failure stop us. We took each failure as a lesson in learning more about propagation and how weather, cloud cover, and the Doppler shift greatly affect signals on UHF. We also learned how much a 25 mph wind with sleet and snow in 17-degree air temperature can make fingertips turn blue and numb in a matter of a minute. Yes, I know, "Where was your glove?" It was in my pocket because I could not use the keypad on the TH-D72A with a gloved hand. (Again, I remembered something I already knew — wind chill; but I was chasing DX!) The fingers recovered by the way.

During at least a dozen multiple failures, our hope were beginning to fade. We both

wondered if our modest setups would even be able to do the job. After all, we were basically QRP into handheld Yagis.

We expected March 28, 2017, to be a failure, as Dave informed me that he had rain in his area but that he was going to try anyway. We still hoped that this attempt would be a success. It was time to try it again.

As the ISS came up just below my horizon, I started beaconing, but all I could hear at first was some Midwest stations who were able to hit the digipeater. All of a sudden, VA7THO showed up on my display. I sent him a message, but I heard nothing from him. As others made contacts (thank goodness there were no stations beaconing every two seconds), I sent him another message and then got a reply. It was done! After about six weeks of planning and trying to connect, we did it. We each took a series photos of our displays and mailed some to AMSAT for review and confirmation. We were informed about a week later that we had indeed set a new ISS UHF digipeater record. Dave told me a story about what also occurred at the time of the contact. Here is his story.

"There I was, sitting in the back of my SUV, open hatchback keeping the rain off the Yagi, which was supported by a tripod and aimed for the stars. Well not really. Aimed for the International Space Station, which was due very soon. The engine running and the heater on made sure I was comfortable as I stared at my faithful Kenwood handheld transceiver. The previous dozen or more attempts had failed, but it was a time for optimism (see Photo 1).

"Suddenly the little screen lit up with not one, but three call signs. One from Kansas (I found out later), one from Colorado, and the important one — the reason I was there and not home with a TV and bottle of wine — W8LR, Jerry in Ohio, who organized this endeavor to set a record for distant UHF APRS exchange of messages. Hastily, I consulted my instruction sheet and sent my reply. I was rewarded with an "ACK" on my screen for a second or two."

Time to Go Home

"Two weeks later the UHF digipeater was replaced by VHF. We made it! "I might say 'the rest is history,' but that would be inappropriate.

I had been fascinated by the ISS ever since I became a ham six years ago. I once logged into the bulletin board as it flew by (Don't try it. It monopolizes the system and keeps everyone else out). But I had never used the messaging feature of APRS (except to send e-mails once or twice). I am excited to have had a chance to help with this project."

As you can see, Amateur Radio holds opportunity for many forms of radio sport. In this case, it also offered continued educational opportunities for us as hams with hands-on learning as Dave and I have had, as well as the opportunity to display it in front of educators at a school parking lot that I was using to try to make contact with Dave.

The ARISS program and AMSAT go a long way to helping further, in some students, the hunger to become scientists and engineers, and for others, who are not so inclined, the opprotunity to embrace a new hobby that will help them learn new things and develop friendships, some distant, that could last a lifetime.

In this effort, some educators from the school have expressed some interest, and "coolness," in seeing how a request for a scheduled school contact with one of the ISS hams could be submitted for approval. Gee, all of this from just wanting to play radio and DX!

eBay Sellers Donate to AMSAT

Are you an eBay seller? One item, ten items, or a full-time business you can donate a percentage of your winning bid to AMSAT.

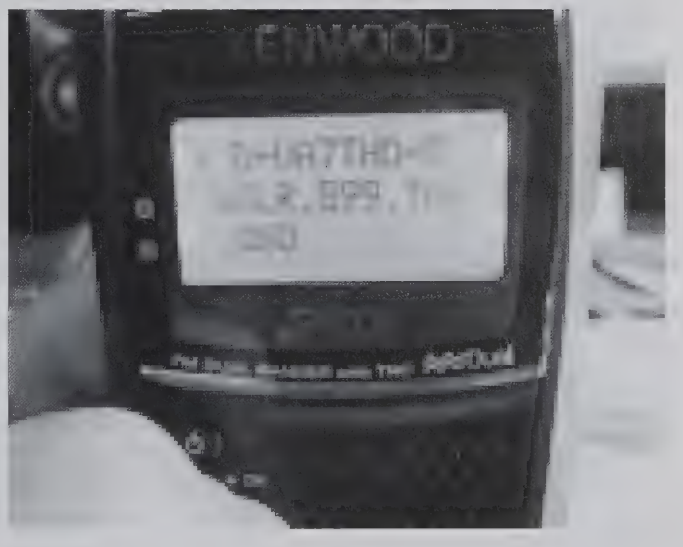
To do so, do not list your item with the basic listing tool, select advanced tools. eBay will give you a warning message that it is for large volume sellers, however this is where the eBay for Charity tool is found.

You can "select another nonprofit you love" and search for either AMSAT or Radio Amateur Satellite Corporation. Choose the percentage amount of the sale you would like to donate to AMSAT, and boom!.

When your item sells and the winning bidder pays, eBay will deduct the percentage from your take and forward it to AMSAT.

Sometimes we are getting rid of our old equipment, sometimes selling something new. In any case, please consider giving a piece of the pie to a new satellite and choose AMSAT for your eBay Charity.

Almost a Faraday cage, but stayed dry.



From W8LR's QTH.

Going Portable with the Amateur Radio Satellites

By Keith Baker, KB1SF/ VA3KSF

[Portions of this article previously appeared as "Going Portable with the Amateur Radio Satellites" in the April, 2017 edition of The Spectrum Monitor *— Ed.]*

It's springtime here in the Northern Hemisphere. And while the higher HF Bands are beginning to go all but silent for the next few years, many of us amateurs, being an experimental lot, are looking for some other way to get our signals out and be heard. One of those ways (that I have been writing about on these pages) is via our growing fleet of amateur radio satellites. And, yes, I've heard all the laments that getting on the satellite is "too hard" or "too expensive" for you or that you live in a deed-restricted area that prohibits outside antennas. Or, perhaps while not being strictly prohibited, you simply don't have the room (or the spouse approval?) at your home to put up an antenna array that might make your humble abode look like a NASA tracking station.

Well, my friends, there IS a way for you to get on the "birds" without breaking the bank or making your home look like something out of a Star Trek movie. And, very much like I wrote in a previous feature in TSM about putting your HF operations "on the road", satellite work can also be done portably with the right combination of antennas and radios.

Going Hand-Held

Probably the easiest (and cheapest) way to operate on our satellites is via a small, hand-held portable antenna array along with one or more FM Hand-held transceivers.

And, contrary to what you might believe, you don't need a super powerful FM transceiver with these antennas to work the birds. In fact, I (and many other amateur satellite operators) have sometimes met with success using just a simple dual-band hand-held radio and an antenna with just a bit more gain than the ordinary "rubber duck."

That is, over the years, I (and others) have had minimal success using an "extended rubber duck" on these transceiver(s) to make a few contacts on our FM satellites (such as SO-50 and AO-85) on near overhead passes.

However, because the downlink output power on most of our satellites is usually pretty weak (often less than 1 watt) and because of the "capture effect" of FM signals, you'll have far better success if you can create some signal gain on both the downlink (from the satellite) as well as on your uplink (to the satellite).

Several people have "rolled their own" Yagi satellite antennas using nothing more sophisticated than a series of trimmed coat hangers mounted on a block of wood. However, for many years (and for most of my own non-permanent, portable satellite contacts) I've been using a commercially made, hand-held antenna from Arrow Antenna of Cheyenne Wyoming.

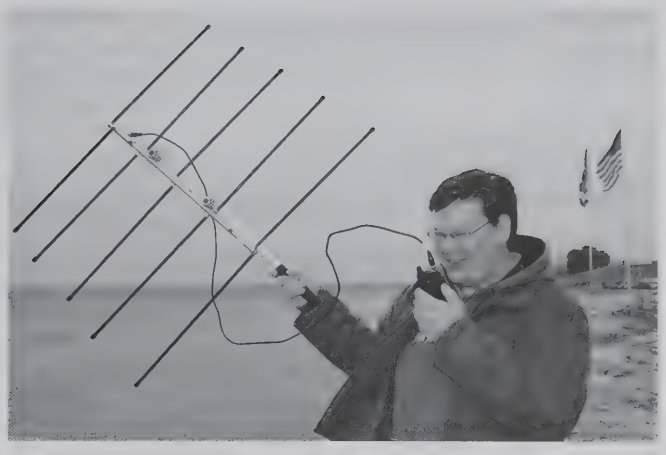
The Arrow

The Arrow II Satellite Antenna Model 146/437 provides an impressive forward gain of approximately 10.3 dBd at 70cm and 4.6 dBd at 2 meters. Sturdily machined from aluminum arrow shafts (hence the name) this antenna actually consists of two antennas mounted at right angles to each other on the same boom…a three element Yagi for 2 m and a seven element Yagi for 70 cm. A removable foam handgrip plus threaded horizontal and vertical photo tripod mounting holes underneath the handgrip make this a totally collapsible antenna that

I often use a Kenwood TH-78A dual-band HT and a lightweight Arrow Antenna to make contacts through one of our FM amateur radio satellites from the shores of Lake Huron in Michigan. When used with a 5 watt, full-duplex handheld in an open location free of foliage (such as a beach or a field) the antenna provides enough uplink and downlink gain to successfully work the FM "birds," even on passes close to the horizon. [Courtesy: KB1OGF.]

Your author's wife, Kate Baker (KB1OGF/VA3OGF), makes a contact through one of our FM amateur radio satellites from the shores of Lake Huron in Michigan with a Kenwood TH-78A dual band HT. The extended "rubber duck" (MFJ Model 1717 from MFJ Enterprises) antenna and about 5 watts of uplink power provides just enough gain on the uplink and downlink to briefly work these satellites on near overhead passes. [All following photos by Keith Baker unless otherwise noted.]

During AMSAT's 2016 "Symposium at Sea", AMSAT's Secretary, Paul N8HM makes a nighttime QSO using a hand-held Alaskan Arrow antenna and a pair of Yaesu FT-817s from the deck of the cruise ship Carnival Liberty in the Gulf of Mexico.



Another popular commercially made hand-held satellite antenna is the Elk. Here, Craig Wolsey, AC8EJ/VA3ICW, uses his HT and an Elk Model 2M/440L5 antenna to make a contact through one of the AMSAT satellites from the shores of Lake Huron in Canada. The antenna's unique log periodic design allows for dual band VHF/UHF operation using just five elements connected to a single feed line, all without the need for a diplexer.

is also useful for terrestrial radio direction finding or portable emergency work.

With models starting at about US $75, the Arrow is very well constructed and can be easily taken apart (some models even have a split boom!) for extended portable use. A somewhat more expensive version also sports a 10-Watt duplexer (or more correctly, a "diplexer") in the handle, which, if your radio can operate in full duplex mode, requires only a single feed line.

I actually own four of these split-boom and duplexer-equipped Arrow antennas and I remain absolutely delighted with their performance. One of them, along with my Kenwood TH-78A handi-talkie (HT), goes with me in my vehicle or suitcase whenever I travel. Using my Arrow and my HT, I've been able to consistently work thorough AO-85 and SO-50 down to about 10 degrees elevation.

As of late, the Arrow is now being offered in an "Alaskan" version, which offers a bit higher gain, ostensibly for use in far northern latitudes (or if you are using really low power on the uplink). This model sports an extra element on 2 m and three extra elements on 70 cm.

AMSAT usually carries a supply of both the Alaskan and standard versions of these antennas available via their online "store" on the AMSAT Web site (store.amsat.org/catalog/). Several Amateur Radio dealers also offer various versions of the Arrow Satellite Antenna in their catalogs, or they can be ordered directly from the manufacturer at www.arrowantennas.com.

The Elk

Another variant of the hand-held satellite antenna genre is called an "Elk". This antenna sports a log-periodic design for 2m and 70cm that allows for a single feed line and is available directly from the manufacturer at https://elkantennas.com/product/dual-band-2m440l5-log-periodic-antenna/. As the boom material is manufactured from standard PVC pipe material, it is easily mounted on a photo tripod with just a few extra pieces of PVC piping from your local "big box" hardware store.

Arrow On a Tripod

Because the Arrow boasts threaded receptacles under the foam grip that make it suitable for mounting on a photo tripod, a while back a good friend of mine, Art VE3GNF was intrigued by an article in the March /April 2013 issue of *The AMSAT Journal* by Rick Tejera K7TEJ.

Rick wrote about an equatorial mount for satellite antennas using one designed for a small telescope and adapted for satellite tracking. Having the same interests as Rick, Art believed that he could produce a functioning system "really cheap". Thus, the birth of what he has come to call

A number of AMSAT's experimenters have adapted the Arrow Antenna design to a wide range of unique tracking mounts. Here, Art VE3GNF shows off his "Gizmo" mount. The design features a small counterweight and "plumber's tee" that allows for a single movement (similar to an equatorial telescope mount) to track satellites across the sky.

"The Gizmo". Much like an equatorial astronomical telescope mount (and with the addition of a small, 12 volt DC motor along with some fabricated parts) the Gizmo allows you to track the satellites across the sky from your operating position with just a single movement.

I've worked a number of satellites using one of Art's Gizmos and have found that, once you set the parameters for an upcoming satellite pass, positioning the antenna array with just a single movement really helps to simplify the inherent complexities of amateur satellite tracking and operation.

Old U-110 Rotators

Another approach to portable satellite antenna arrays I've used consists of two old Alliance (Genie) U-110 television antenna rotators. The U-110 is particularly useful because, unlike most of the more modern TV rotators, the U-110 allows for a TV-mast-sized "boom" to be mounted right through the rotator housing. This feature, in turn, greatly simplifies mounting and operating the elevation part of your portable satellite array using these rotators.

Unfortunately, U-110 rotators are becoming increasingly hard to find, even online or in the junk boxes of "flea markets" at hamfests. At one time, the (pre-MFJ) Cushcraft Corporation also made a customized, boom-to-mast kit for U-110s. But, these, too, are becoming increasingly hard to find. On the other hand, if you do happen to come across two of these rotators and also have access to a machine shop, fabricating a boom-to-mast plate for these rotators makes for an interesting project.

Personally, I've had good success working through the Low Earth Orbit (LEO) satellites using a pair of standard-sized (10 element VHF and 22 element, singularly polarized UHF) arrays mounted on a metal cross-boom with a Cushcraft boom-to-mast kit. The array is rotated with two U-110 rotators all mounted on TV antenna masts and a small TV-type roof tripod.

Now, satellite purists will tell you that mounting any UHF or VHF satellite antenna with a metal cross boom protruding through the middle of the antenna elements will destroy the radiation pattern. However, I've found that rotating the antenna array elements at least 45 degrees to the boom helps to very much minimize this effect.

A Pair of Arrows

Another approach to portable satellite operation is to mount two Arrow-style antennas on opposite ends of a cross-boom and feed the dual 2 m and 70 cm elements together with RG-59 (72 Ohm) phasing coax lines. If the two sets of antenna elements are also mounted 90 degrees from each other, this arrangement creates a "pseudo circular" radiation pattern that can help offset the sometimes deep fades one encounters in satellite uplinks and downlinks when your antennas are cross-polarized with those of the satellite. The only real downside to this arrangement is that it almost always requires a more expensive rotator arrangement (such as a Yaesu G-5400 or 5500 Az/El combo) to rotate the array properly.

Mounting It All

Finding the right mounting tripod and mast material to mount your rotators and cross boom can also present somewhat of a challenge. However, I've since found that any number of DJ speaker stands (E-Bay is your friend here) or something similar to MFJ's Model 1918 tripod work just beautifully to support your portable array. For example, a few years back, our local radio club used this portable satellite antenna arrangement to good advantage during the ARRL Field Day, making several contacts on a number of both the FM and linear (analog) satellites.

The M2 "LEO Pack"

And then, like most other aspects of our wonderful amateur radio hobby, there will always be those who want to do it First Class. For those folks who want to take their satellite operating to the field in style, I highly recommend using M2 Antenna System's "LEO Pack" (http://www.m2inc.com/amateur/leo-pack/).

This antenna package consists of M2's Model 436CP16, circularly polarized Yagi for 70 cm and their Model 2MCP8A, circularly polarized Yagi for 2 m. Either antenna can be assembled using right-hand or left-hand circular polarization, although most veteran

ARRL's Field Day is a great opportunity to try out different portable satellite antenna designs. Here, a pair of Arrow-style antennas are used with 75 Ohm phasing lines to achieve a "circular-like" radiation pattern. The rotator is a Yaesu G-5400 Az/El combo and the tripod is a DJ speaker stand, both obtained from E-Bay.

In recent years, M2 Antenna Systems has marketed their "LEO Pack" consisting of their Model 436CP16, circularly polarized Yagi for 70cm and their Model 2MCP8A, circularly polarized Yagi for 2m. The array is shown here being used during a recent DXpedition to St. Paul Island, Canada. [CY9C, photo.]

satellite ops choose the right-hand circular option. The package also includes a three-piece boom and mounting plate that you may (or may not) need to use depending on your rotator and cross boom selection.

During January and February of 2017, I used one of these LEO packs at our family's rental cottage on Fripp Island in South Carolina. Using a TS-2000 in the satellite mode and a Mirage pre-amplifier (their Model KP2/2m) on the 2 m downlink (along with two lengths of about 50 feet of Belden 9913 low-loss coaxial cable) I was able to work any other satellite station I could hear. As of this writing (late February) I've since confirmed well over 50 "grid squares" toward the ARRL's coveted VUCC award from that location via their Logbook of the World (LOTW) using this setup. In short, these antennas really work well!

And, what's even more exciting that AMSAT members can now order their very own M2 LEO pack from the AMSAT online "store" (http://store.amsat.org/catalog/product_info.php?cPath=1&products_id=123) at a somewhat reduced price from retail. If you order it that way, M2 will also graciously donate some of the proceeds from each sale to AMSAT for our satellite construction activities. Clearly, this is a "win-win" for both of our organizations.

Do I Need a Pre-Amp?

One of the questions I'm frequently asked by budding satellite operators is whether (or not) a receive pre-amplifier on the downlink side of a satellite antenna array is needed. The short (flip!) answer is, "It depends". That is, it depends on the gain in your downlink antenna, the length and type of feed line you use and whether (or not) there is a receive pre-amplifier already installed in your radio. Having used many different combinations of antennas, feed lines and satellite-capable radios over the years, I've found that, unless you are using long lengths (greater than 50 feet) of higher loss coaxial cable (such as RG-58, RG-8, RG-8X or RG-213 that are better suited for HF operation) you can usually get by with using just the pre-amplifier in your radio…if it has one.

My suggestion is to simply try out the best combination of these elements that you can assemble and see if that arrangement gives you acceptable results. Most of the time, if you are using a hand-held antenna, external receive pre-amplifiers are not needed to bring your received satellite signals up to a readable level, even when using short lengths of RG-58 or RG-8X cable. But, mounting your antenna array on a rotator-equipped tripod with a longer length of higher-loss feed line may generate the need for some more receive gain on the downlink.

Bottom Line

Once again, it is important to remember that satellite work is weak signal work. You need to discard the "S9+" approach from your HF operations while working the birds. All that is required (if working full duplex) is that you be able to hear your own signals through the satellite with a "copyable" downlink signal, period! Anything beyond that is overkill and simply robs downlink power from others who are also just trying to be heard through the transponder.

But, just like as other aspects of our wonderful radio hobby, the bottom line here is to not be afraid to use what you may already have lying around (in your garage or junk box) to experiment with different approaches to mounting and turning your portable satellite array.

And, I very much look forward to "seeing you on the birds"…from my (and your) very own portable satellite setups in the weeks and months of beautiful Summer weather just ahead.

A portable satellite antenna array can also be used in a semi-permanent (or even permanent!) setup. My principle satellite antennas consist of an M2 Model 2MCP14 for 2 m and a M2 436CP30 for 70 cm. The array is mounted on a metal cross-boom with a Yaesu G-5400 rotator and an MFJ Model 1921 Heavy Duty tripod. Mounting the 2 m antenna at a 45-degree angle on the cross boom helps to minimize interference to the circularly polarized pattern.

"Now THAT'S a strange pair or antlers!" A passing deer at our family's rental home on Fripp Island, South Carolina eyes my M2 "LEO Pack". Fripp Island is a nature preserve and the deer roam free.

AMSAT Goes to the Moon with the Cube Quest Challenge

Howie DeFelice, AB2S

1. What is the Cube Quest Challenge?

The Cube Quest Challenge (CQC) was initiated by NASA's Centennial Challenge Program to award prizes to "citizen inventors" who can design, build, and operate CubeSats that successfully achieve lunar orbit – or else a range of 4 M km – and then successfully demonstrate prescribed performance achievements of the kinds needed for future NASA missions. Though competitors may arrange their own launches in order to compete, qualified teams will be offered a free ride on NASA's EM-1 mission. That mission, planned for launch in 2018, will be the first un-crewed lunar flyby of the Orion capsule mounted on the Space Launch System (SLS). NASA's Exploration Systems Directorate specified that the SLS would be designed to have capacity for 13, 6U-sized CubeSats, which could be loaded with any secondary payloads. The secondary payload dispensers are mounted inside a ring as part of the Interim Cryogenic Propulsion System (ICPS). The secondary payloads would be deployed after Orion separates and the ICPS performs a collision avoidance maneuver. The ICPS trajectory (and the non-propulsive trajectory of its deployed CubeSats) will be a lunar flyby trajectory that ultimately continues into heliocentric orbit.

NASA's Space Technology Mission Directorate (STMD) challenged its Centennial Challenges Program to determine a useful public prize that could make productive use of three of these available secondary payload slots. The CQC team consulted the CubeSat developer community, NASA stakeholders, other government agencies, and the STMD sponsors while crafting the rules of the competition during a period lasting from the fall of 2013 until fall of 2014. Two drafts of the CQC rules and proposed prize structure were released to Federal Business Opportunities for the Request for Information. Relevant comments from the CubeSat developer community were incorporated into redrafts of the rules.

The final challenge scenario will be based on a number of considerations:

A. Deep Space Derby

The demonstration of advanced capabilities for high-speed, very long-range communications from a CubeSat to an Earth ground station, over a sustained period, will be a huge milestone for CubeSats designed to operate in deep space. For the Deep Space Derby, prizes would be offered for achieving a minimum data rate, minimum data volume over a specified time interval, closing a communications link for distance at least 4M km, and for spacecraft longevity at this range, as demonstrated by counting the elapsed number of days between the first and the final successful spacecraft communication dates. The 4 M km range is almost 10 times the distance from Earth to the moon. For challengers to be eligible for prizes, NASA would independently verify the range and the communication achievements.

The Deep Space Derby described above, and the prizes awarded, center on communications accomplishments. That is because radio (or optical) transmissions are straightforward ways to demonstrate satellite activity. However, achieving high data rate communications from a very long range, and surviving to communicate after many days or weeks, necessitates the CubeSat designer to stretch the entire system of CubeSat capabilities. For example, to communicate long distances requires precision navigation and attitude determination to aim a high-gain antenna to Earth. To date, no CubeSat has navigated without the aid of GPS or Earth's magneticc field. Both are unavailable to our Deep Space Derby challengers.

CQC teams may employ NASA's DSN high-gain antennas for their ground station needs. However, they must do so at their own cost and they must vie with all the other EM-1 payloads and the NASA mission to schedule aperture time. Some of the CQC teams indicate they intend to use alternative ground stations or to design their own. Exercising the capabilities of these non-NASA ground station resources will pave the way for other inexpensive private missions to come.

High RF communication rates imply high-powered transmitters, requiring advanced power generation and power management tactics, especially challenging when solar array sizes are limited by the small 6U CubeSat volume. To communicate over a range of many weeks, the CubeSat must be designed to tolerate the high radiation environment of deep space. Exposure times and dosages are much greater here than they are in low Earth orbit.

Likewise affecting longevity, the ambient thermal environment of deep space is different than for CubeSats in LEO. Traveling away into heliocentric orbit, CubeSats will not have the thermal radiation from Earth's albedo, yet still have to cope with the internal heat dissipated by large radio transmitters enclosed in the small 6U volume. As stated above, the CQC contestants who develop these advanced CubeSat capabilities will be creating the technologies needed for future NASA and other exploration and science missions.

One simplifying factor of the Deep Space Derby is that, at least for those deployed from SLS, the CubeSats will not need to include any propulsion system (other than that needed for attitude control). The SLS will deploy its EM-1 payloads into a hyperbolic lunar flyby trajectory so that they will be at a range of 4 M km within a few days after deployment, even without propulsion. This simplification leaves designers with more volume, mass, and power for their transmitters and other electronics.

B. Lunar Derby

Similar to the Deep Space Derby, contestants in the Lunar Derby will demonstrate high-speed data communications and long-term viability, but only after they have first achieved a lunar orbit (as specified and verified by NASA). Again, prizes will be offered for achieving a minimum data rate, minimum data volume over a specified time interval, and for spacecraft longevity while in lunar orbit, as demonstrated by counting the elapsed number of days between the first and the final successful spacecraft communication dates. Another prize will be given to operators who successfully insert their CubeSat into an orbit specified by NASA. As in the Deep Space Derby, NASA will independently verify the lunar orbital trajectory and the communications achievements.

Achievements of the communications goals would require designers to deliver a CubeSat with all the system capabilities listed in the Deep Space Derby objectives. Additionally, the developers must include a propulsion system, and operators must navigate their spacecraft into lunar orbit after being deployed by the SLS or their third-party launch vehicle. Based on preliminary trajectory and deployment concepts for EM-1, the CubeSats are estimated to need to achieve about 700 to 900 m/s delta-V to be inserted into a stable orbit. What's more, they will need continuous navigation, either autonomously

or via Earth-based command and control, to station-keep that orbit while attempting the communications achievements. The satellite power management systems must also cope with Earth and lunar eclipses while generating and storing solar electric power.

2. AMSAT's Role in the Cube Quest Challenge

AMSAT is delivering the communications capabilities to Ragnorak to provide: command and control between the spacecraft and ground; ranging data for orbit determination to approximately 15 M accuracy; high-speed data for Lunar Derby competition; and amateur radio transponder for post-mission usage.

AMSAT also will promote participation in the reception and reporting of ranging measurements and Lunar Derby data. The design of the communications package will serve as a model for future high-altitude CubeSat payloads.

3. Ragnarok Heimdallr Satellite Overview

The Ragnarok 6U CubeSat will be inserted into a lunar trajectory by the NASA SLS vehicle. The spacecraft controllers will use a low energy, long duration electronic thruster to gradually ease the satellite into lunar orbit. Gravitational capture by the moon will take three to four months to achieve, and another three months to spiral down to the desired orbital height. The satellite will use three-axis stabilization with rate gyros for attitude control. A star tracker and sun sensor will aid in attitude determination. A steerable solar array capable of generating up to 100 W of power will generate the large amount of power required for the Hall effect electronic thruster. The communications equipment will use both directional patch arrays and omnidirectional antennas.

4. Importance to Amateur Radio

In an era where everyone is continuously and wirelessly connected across the world, the traditional value of amateur radio as a medium for remote communications is not as compelling as it once was. The challenges of a lunar mission provide many exciting areas to develop interest among the current generation of experimenters. Flying a satellite a million kilometers away using a digital communications link you helped design is way better than flying a quad copter in the back yard. AMSAT also has an opportunity to show its value to the scientific community. This will be the only CQC mission that will use a volunteer network of amateur radio operators to provide the tracking and orbital determination data for a lunar mission. For AMSAT, this marks the return to high earth orbit.

5. Comms Payload

As mentioned earlier, the communications payload will provide the necessary telemetry, tracking and control functions required to fly and operate the satellite. The primary mission will end in approximately one year. At that time, the satellite will be turned over to AMSAT to operate as a communications satellite. The downlink will be in the 10.5 GHz band with the uplink in the 5.6 GHz band. The primary mode will be a digital regenerative transponder. The digital transponder will have four 5 Kbps digital voice uplinks. Each of these uplinks will be regenerated on the satellite and multiplexed onto a single 25 Kbps downlink.

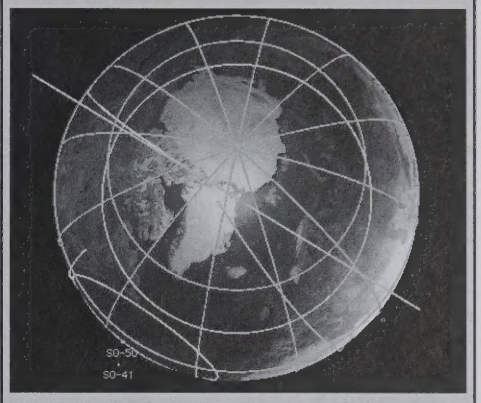
By regenerating the signal on the satellite, all the noise added on the uplink is removed before being re-transmitted to the ground. The satellite will also have a linear transponder in the same band as the digital transponder. The primary purpose of the linear transponder is to allow the ranging function to be carried out in case of a failure of the SDR radio used in the digital transponder. Since it will be on the satellite, we can make it available for those with EME class stations on a scheduled basis.

6. Required Equipment

The AMSAT ground terminal being developed for P4 will also work with this satellite. The proposed 1 m antenna on the ground terminal will work for receiving telemetry and making ranging measurements. To communicate using the digital transponder, the antenna will need to be upgraded to about 1.8 m using the current link budget. Work is underway to try to squeeze a little more gain from the spacecraft antenna to reduce the groundside antenna. There is plenty of room for home brewing and innovation as well. Low-cost TVRO LNBs are available on eBay and a low-cost RTL-SDR should be capable of receiving the downlink with the appropriate software. The uplink is a little more difficult but may be possible using transverters with a radio capable of generating the 5 Kbps BPSK uplink. New SDR platforms are becoming available at reasonable prices that will be able to transmit at 5.6 GHz directly without the need of a transverter. The uplink will require about 48 dBW of EIRP or 10 watts into a 1.8 m antenna.

MacDoppler

The premier Satellite tracking and station automation application for the Macintosh - OS 9 & OS X



MacDoppler for Cocoa gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to a fully automated Satellite Gateway!

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A Universal Binary that runs native on Intel and PPC Macs and provides separate panels for the map (2D or 3D), the radio and rotor controls, a sorted table of upcoming satellite passes and a Horizon panel that graphs upcoming passes as a function of elevation over time.

Now available from AMSAT at a special member discount donation!

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Support AMSAT

AMSAT is the North American distributor of SatPC32, a tracking program for ham satellite applications. For Windows 98, NT, ME, 2000, XP, Vista, Windows 7, 8/8.1 & 10.

Version 12.8c is compatible with Windows 7, 8/8.1 & 10 and features enhanced support for tuning multiple radios.

Version 12.8c features:

- SatPC32, SatPC32ISS, Wisat32 and SuM now support rotor control of the M2 RC-2800 rotor system.
- The CAT control functions of SatPC32, SatPC32ISS and Wisat32 have been expanded. The programs now provide CAT control of the new Icom transceiver IC-9100.
- The main windows of SatPC32 and SatPC32ISS have been slightly changed to make them clearer. With window size W3 the world map can be stretched (only SatPC32).
- The accuracy of the rotor positions can now be adjusted for the particular rotor controller. SatPC32 therefore can output the rotor positions with 0, 1 or 2 decimals. Corrections of the antenna positions can automatically be saved. In previous versions that had to be done manually.
- The tool "DataBackup" has been added. The tool allows users to save the SatPC32 program data via mouse click and to restore them if necessary. After the program has been configured for the user's equipment the settings should be saved with 'DataBackup'. If problems occur later, the program can easily restore the working configuration.
- The rotor interfaces IF-100, FODTrack, RifPC and KCT require the kernel driver IOPort.SYS to be installed. Since it is a 32-bit driver it will not work on 64-bit Windows systems. On such systems the driver can cause error messages. To prevent such messages the driver can now optionally be deactivated.
- SuM now outputs a DDE string with azimuth and elevation, that can be evaluated by client programs. Some demo files show how to program and configure the client.

Minimum Donation is $45 for AMSAT members, $50 for non-members, on CD-ROM.
A demo version may be downloaded from http://www.dk1tb.de/indexeng.htm
A registration password for the demo version may be obtained for a minimum donation of $40 for members and $45 for non-members.
Order by calling 1-888-322-6728.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.

The AMSAT Journal Needs Your Words and Wisdom

The AMSAT Journal is looking for interesting articles, experiences and photos to share with other AMSAT members. Writing for the *Journal* is an excellent way both to give back to the AMSAT community and to help others learn and grow in this most fascinating aspect of the amateur radio avocation.

Find a quiet place, sit yourself down, get out your laptop or pick up a pen, and ...

1. *Launch* your inner writer;
2. *Downlink* your knowledge and experiences to others by:
   - Sharing your adventures in the "On the Grids" column or
   - Describing your AMSAT career in "Member Footprints;"
3. *Transmit* lessons learned from operational and technical projects;
4. *Log* some of your more interesting passes across the sky; and
5. *Boost* others to a higher orbit of know-how and experience.

After your article lands in members' mailboxes, and the kudos start arriving for your narrative payload, you can enjoy the satisfaction of knowing you've elevated the collective wisdom of AMSAT to a higher trajectory.

Send your manuscripts and photos, or story ideas, to: **journal@amsat.org**.

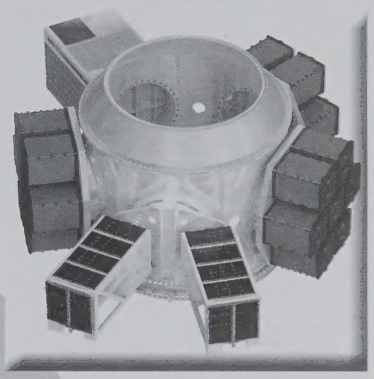
Our editors are standing by!

AMSAT Fox-1Cliff & Fox-1D $125,000 Launch Initiative Goal

AMSAT is excited to announce a launch opportunity for **BOTH** the Fox-1Cliff and Fox-1D Cubesats. In response to a breaking opportunity, AMSAT and Spaceflight, Inc. have arranged for Fox-1D to accompany Fox-1Cliff on the maiden flight of the SHERPA system on a SpaceX Falcon 9 in the 1st quarter of 2016.

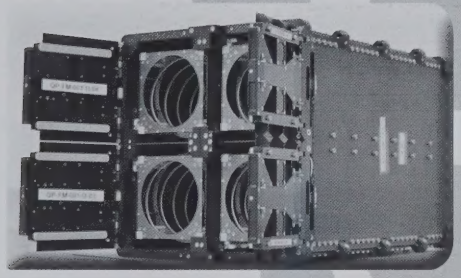
Fox-1Cliff and Fox-1D will provide selectable U/V or L/V repeater capabilities on separate frequencies once in orbit, and will be capable of downlinking Earth images from the Virginia Tech camera experiment.

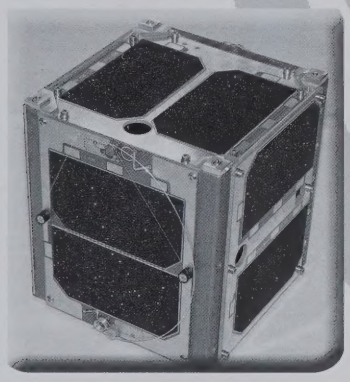
AMSAT has an immediate need to raise funds to cover both the launch contract and additional materials for construction and testing for Fox-1Cliff and Fox-1D. We have set a fundraising goal of $125,000 to cover these expenses over the next 12 months, and allow us to continue to keep amateur radio in space.



Spaceflight's SHERPA will deploy multiple cubesat payloads on-orbit

ISIS QuadPack Nanosatellite Dispenser





Your help is needed to get the AMSAT Fox-1Cliff and Fox-1D 1U Cubesats launched on the Spaceflight's initial SHERPA flight.

For the latest news on Fox-1 watch our website at www.amsat.org, follow us on Twitter at "AMSAT", or on Facebook as "The Radio Amateur Satellite Corporation" for continuing news and opportunities for support.

Donations may be made through the AMSAT webpage at www.amsat.org, by calling (888) 322-6728 or by mail to the AMSAT office at 10605 Concord Street, Kensington, MD 20895, USA. Please consider a recurring, club, or corporate donation to maximize our chance of success with this mission.

AMSAT President's Club Support Fox-1Cliff and Fox-1D

Contribute to AMSAT directly through easy, automatic charges to your credit card. Since AMSAT is a 501(C)(3) organization donations may be USA tax deductible. (Check with your tax advisor.) To join contact Martha at the AMSAT Office by phone (888) 322-6728 in the US, or (301) 822-4376; e-mail **martha@amsat.org**.

Titanium Donors contribute at least US $400 per month	❒	$400 / month
	❒	$4800 one time
Platinum Donors contribute at least US $200 per month	❒	$200 / month
	❒	$2400 one time
Gold Donors contribute at least US $100 per month	❒	$100 / month
	❒	$1200 one time
Silver Donors contribute at least US $50 per month	❒	$50 / month
	❒	$600 one time
Bronze Donors contribute at least US $25 per month	❒	$25 / month
	❒	$300 one time
Core Donors contribute at least US $10 per month	❒	$10 / month
	❒	$120 one time

AMSAT is Amateur Radio in Space ... and YOU are AMSAT!

Seize opportunities to launch your amateur radio experience to new heights!

ARISS Development and Support

AMSAT's Human Space Flight Team is looking for volunteers to help with development and support of the ARISS program:

- Mentors for school contacts
- Support for the ARISS web
- Hardware development for spaceflight and ground stations
- Help with QSL and awards certificate mailing.

To volunteer send an e-mail describing your area of expertise to Frank Bauer at: **ka3hdo@amsat.org.**

AMSAT Internet Presence

AMSAT's information technology team has immediate needs for volunteers to help with development and on-going support of our internet presence
:

- Satellite status updating and reporting.
- Add/delete satellites to ANS and the web as needed.
- Research and report satellite details including frequencies, beacons, operating modes.
- Manage AMSAT's Facebook and Twitter presence.

To volunteer, send an e-mail to Drew Glasbrenner, KO4MA at: **ko4ma@amsat.org.**

AMSAT Engineering Team

AMSAT Engineering is looking for hams with experience in the following areas:

- Attitude Determination and Control, and Thermal Engineering, to help in the design of high orbit CubeSats.
- Power systems, for CubeSats from 1U through 6U and LEO to HEO.
- Help with solar, power supply, and battery design for both LEO and HEO missions.
- Logistics, for parts procurement, inventory, and distribution.
- Documentation, for designs, tests, and public relations.

To volunteer, please describe your expertise using the form at **ww2.amsat.org/?page_id=1121.**

AMSAT User Services

AMSAT is looking for an on-line store co-manager to update and refresh the AMSAT Store web page when new merchandise becomes available or prices and shipping costs change.

- Add new merchandise offerings
- Delete merchandise no longer available
- Update shipping costs as needed
- Add periodic updates for event registrations
- Interface with the AMSAT Office

To volunteer, send an e-mail to Joe Kornowski, KB6IGK at: **kb6igk@amsat.org**

AMSAT Educational Relations Team

AMSAT's Educational Relations Team needs volunteers with a background in education and classroom lesson development ...

- Engage the educational community through presentations of how we can assist teaching about space in the classroom.
- Create scientific and engineering experiments packaged for the classroom.
- Create methods to display and analyze experimental data received from Fox-1.

To volunteer send an e-mail describing your area of expertise to Joe Spier, K6WAO at: **k6wao@amsat.org**.

AMSAT Field Operations

AMSAT's Field Operations Team is looking for satellite operators to promote amateur radio in space with hands-on demonstrations and presentations.

- Promote AMSAT at hamfests
- Setup and operate satellite demonstrations at hamfests.
- Provide presentations at club meetings.
- Show amateur radio in space at Dayton, Pacificon, Orlando Hamcation.

To volunteer, send an e-mail to Patrick Stoddard, WD9EWK at: **wa4sxm@amsat.org**

You can find more information on the web:
www.amsat.org – click AMSAT – then click Volunteer